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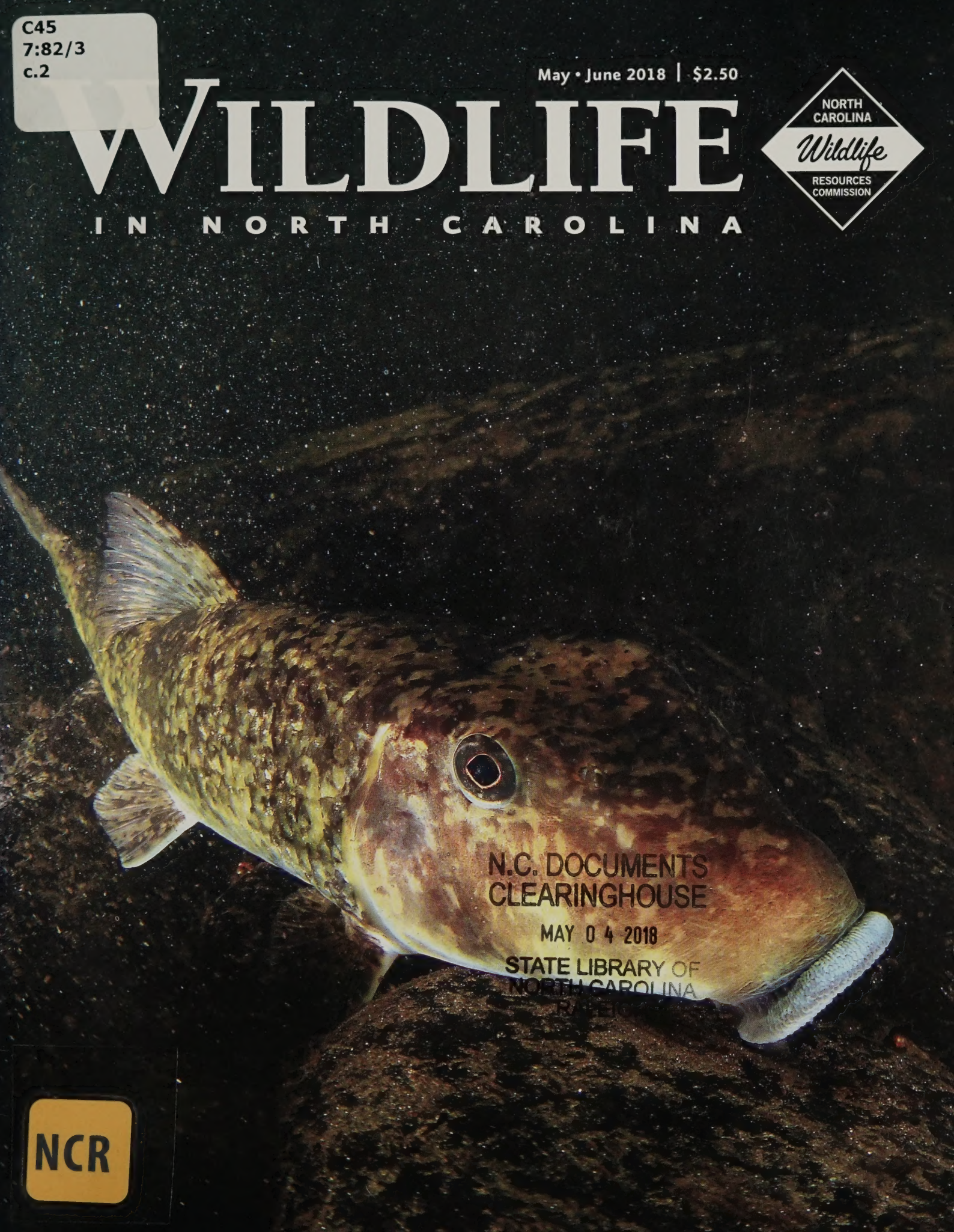
WILDLIFE
IN NORTH CAROLINA

NORTH CAROLINA Wildlife RESOURCES COMMISSION



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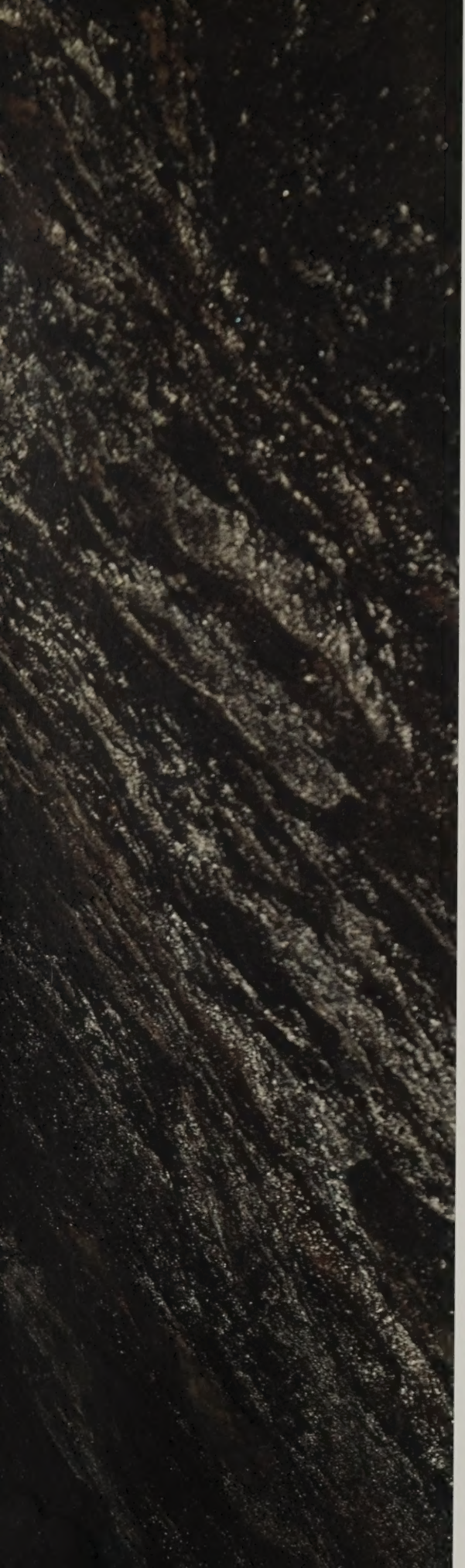
Finding bats in western North Carolina caves has become a challenge for biologists like Katherine Caldwell since the outbreak of a deadly fungus called white-nose syndrome.
PHOTOGRAPH BY MELISSA McGAW/NCWRC.



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Cover: The Northern hogsucker with its distinctive head and lips is a common resident of mountain creeks and streams. PHOTOGRAPH BY TODD PUSSER.

Wildlife in North Carolina is the official educational publication of the North Carolina Wildlife Resources Commission. It is dedicated to the sound conservation of North Carolina's wildlife and other interrelated natural resources and also to the environment we share with them.

EDITOR'S NOTE

I first encountered Stephen Hall at a Wildlife Commission meeting in August 2016 when he received the Thomas L. Quay Wildlife Diversity Award for leadership in the conservation of wildlife diversity in North Carolina. Hall earned the honor by devoting his career to studying and conserving moths, grasshoppers, crickets and other invertebrates, and he spoke passionately about his work and the important role these critters play in our environment.

"I consider myself the champion of moth and grasshopper conservation," Hall told the commissioners while accepting his award. I knew then that I had to meet the champ, not because we share a common interest—I've largely tried to avoid the creatures he pursues—but because he must truly be unique. I got my chance last fall when I set off for a night of moth sampling with Hall in Duke Forest. I admittedly did not know what to expect—after all, how exciting could moths really be? I've sat next to a bug zapper before.

I could not have been more wrong. It was fascinating. As I describe in my story on page 24, Hall's encyclopedic knowledge of moths, grasshoppers, crickets and other insects makes him quite a tour guide in the woods. Even more impressive is how he put his passion to work to conserve these animals and their habitats during a 25-year career with the Natural Heritage Group, and he continues to do so in retirement as a leader with the N.C. Biodiversity Project.

There are plenty of people and professions who are deserved of the praise that "It takes a special person to be a [fill in the blank]." Teacher? Nurse? Police Officer? Absolutely. Devoting your career to the study and conservation of moths and grasshoppers also earns you a spot on that list.

Same goes for the dedicated biologists I spoke with for my article on white-nose syndrome (see page 32). It's proven to be a physical and emotional challenge for biologists who have dedicated their career to study bats only to see them die in staggering numbers from a fungus with no known cure. Biologists like the Commission's Katherine Caldwell and Kendrick Weeks, and U.S. Fish and Wildlife's Susan Cameron, shimmy into caves and set up mist-nets to catch, tag and release bats. And although the number of bats they find have diminished, they continue their work and remain optimistic about the future.

"There is always a reason for optimism," Caldwell said.

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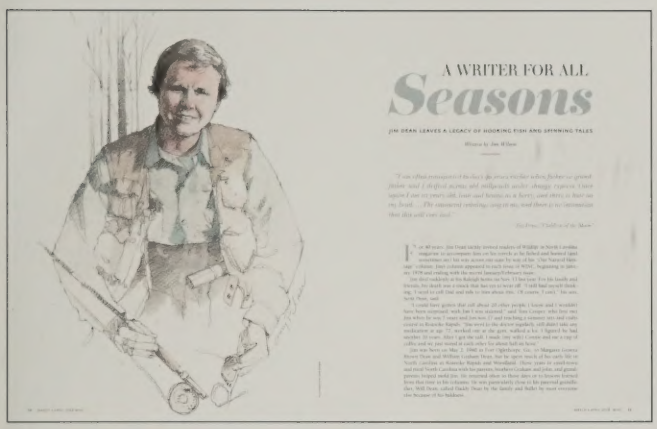

An Overwhelming Response

Jim Dean built quite a following during his 40 years of writing Our Nature Heritage columns. So it should come as no surprise that we have received many notes of sadness, appreciation and memories from Jim's readers following his sudden passing last November. While we cannot publish all of them, we will devote this space for our readers to share their memories of Jim.

Jim Dean's friendship is a gift I will always cherish. He was "one of a kind"—a man of boundless talent. He was a keen observer of the world around him, with the curiosity of a 4 year old. In his last back page article, he describes taking his lunch hour to watch a hive of honey bees come and go. He marvels at the bees' social instincts and ability to communicate. That's classic Jim Dean.

On the subject of "classics"—when Jim and I first met, he drove an original, '60s vintage, Ford Bronco and I had an old International Scout. It didn't take long to realize that we both appreciated stuff that really worked and had stood the test of time. This was the bedrock. It was, as Humphrey Bogart said in the closing scene of "Casablanca," "the beginning of a beautiful friendship." I was reminded of Jim's fondness for things classic when I looked at the recent photograph of Jim holding a shellcracker that appeared in Josh Levanthal's Editor's Note. The fly reel is a vintage Pflueger Medalist, probably made in Akron, Ohio decades ago—the perfect reel for bream fishing.

Although we only got together a few times each year, visited on the phone more often, over time our friendship deepened. I never witnessed any evidence of ego in the man. He treated everyone with respect and openly celebrated their joys and accomplishments. I enjoyed his dry humor. He frequently positioned himself as the butt of the story and in doing so revealed his true humble nature. Needless to say, he was a storyteller extraordinaire. My mom would have described Jim as being "comfortable as an old shoe." He was just that easy to get to know and appreciate. I will always miss him, but my life is much richer for having known Jim Dean.

Dan Cooney
Cary

What a sweet surprise when I reached the last page of the March/April issue to find that you'd reprinted an old Jim Dean column—and will continue doing so for the rest of the year. I am so glad. It's a proper memorial to that terrifically fine writer, whose death was a huge shock. He had seemed so likely to go on forever.

I came to Jim Dean's writing through his two books, "The Secret Lives of Fishermen" and "Dogs That Point, Fish That Bite." The early columns collected in those books seemed full of the two big things that shake us pretty hard in life and also are the subjects of great writing: love and loss. He somehow wrote with restraint while managing to convey deep feelings about friends, family, trout streams, homeplaces, great dogs, wildlife and landscapes close to the heart . . . In later years, long after writing the columns in those books, Jim Dean seemed to write with a lighter heart and with more consistent humor. To my ear anyway.

For ages I meant to write him a fan letter and say what I've just said here. Didn't do it. Sure wish I had.

Ginger Travis
Hillsborough

Thank you for running Jim Dean's recent story on "The Laughing Place." Like so many, I never had the pleasure of meeting him but felt like I knew him from his stories.

I remember reading this story in 1998 and it hit a nerve then. I now live in my Laughing Place, which I consider a blessing but Mr. Dean was right. Pond, woods, river and I have not been fishing or exploring in months, years. Promise to self that this will change. Going shad fishing tomorrow.

Bob Terry
Raleigh

Jim and I became friends 40-plus years ago. We met while working together at the Wildlife Commission. Jim and I share the same love for bass fishing on small ponds. We would throw a john boat in the back of my '56 F100 and often fish more than one pond in a day.

Jim was a great sportsman and photographer. He taught me about flat time, fly-fishing and photography. For several years, Jim and I would go to Edgemont, where he taught me how to fly-fish for trout.

Each and every time I fish a small pond, I think of Jim. He will always be with me.

Jack Avent
Louisburg

While I was delighted to see a photo of a beekeeper among the winners of your annual photo contest (January/February 2018), more delighted to see a bee featured in the Outdoor Moment piece, and completely delighted to read Jim Dean's "The Birds and the Bees," I was heartbroken to read of Mr. Dean's untimely passing.

As a *Wildlife in North Carolina* subscriber for many years, I felt that I knew Mr. Dean even though I never met him. There was just something about his wonderful writing style; it always seemed as though he was a good friend who loved nothing better than telling great stories to me, and to all his other good friends.

There is a poem by John Greenleaf Whittier entitled "Telling the Bees." As a beekeeper myself, I will be sure to tell the bees about the loss of our good friend, Jim Dean.

Jackie Hough
Red Springs

write us

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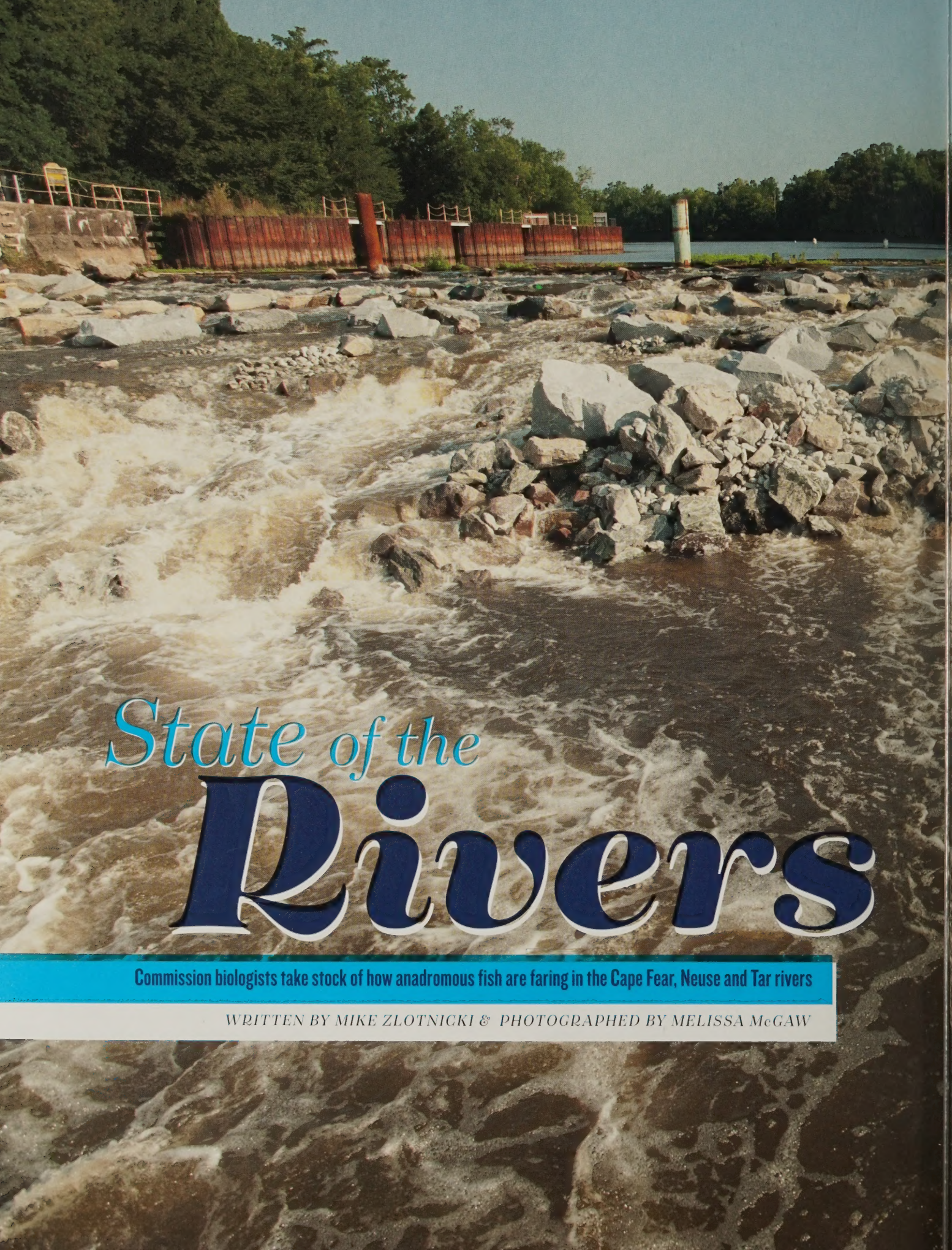
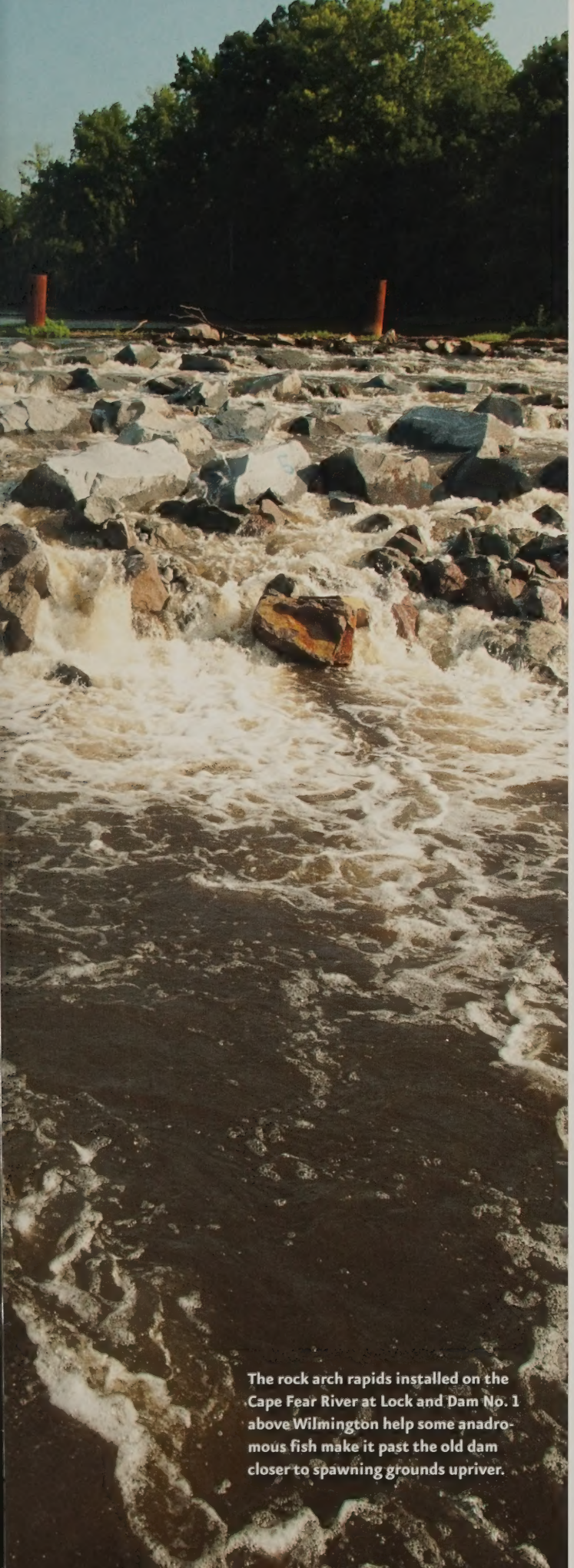


State of the Rivers

Commission biologists take stock of how anadromous fish are faring in the Cape Fear, Neuse and Tar rivers

WRITTEN BY MIKE ZLOTNICKI & PHOTOGRAPHED BY MELISSA McGAW



The rock arch rapids installed on the Cape Fear River at Lock and Dam No. 1 above Wilmington help some anadromous fish make it past the old dam closer to spawning grounds upriver.

The Roanoke River is nationally renowned for its spring shad and striped bass spawning runs, but also for the conservation success in bringing those species back to health from precipitous population levels just a few decades ago.

The Roanoke is not the only river hosting anadromous fish spawning migrations each season (anadromous fish live in the ocean and spawn in freshwater rivers). Let's look at the other major rivers in North Carolina to see how they are faring.

THE NEUSE RIVER

Stretching about 250 miles from Falls Lake Dam to Pamlico Sound (where it has the largest river mouth in the U.S.—6 miles, according to N.C. Department of Environmental Quality), the Neuse made headlines in the 1990s with fish kills, floods, algae blooms and other malaise. It now has a better presence. Like most coastal rivers, the Neuse is home to several seasonal species of anadromous fishes that live in saltwater and spawn in freshwater. Ben Ricks, District 2 fisheries biologist, provided an overview of those species that utilize the Neuse seasonally.

The striped bass population, while present in the Neuse, suffers from low spawning success and a high mortality rate.

"Is there striped bass reproduction? That's a difficult question," Ricks said. "Not because of the answer, but because of the results. The answer is yes, we collect spent females, we find spawning aggregates of fish on the spawning grounds. We've collected eggs that have been spawned by striped bass. They are going through the motions, but unfortunately their efforts are not resulting in a natural year-class production. We're seeing eggs, but we're not seeing wild 4-inch stripers around."

Ricks said that genetic data shows that at least 80 percent of the striped bass in the Neuse are stocked fish, and it's likely that percentage will increase in time after more testing.

The stocking program is a partnership between the Commission and U.S. Fish and Wildlife Service. The Commission collects the stripers and the federal fish hatchery in Edenton picks up the fish, spawns them, grows them and eventually stocks them in the river, usually November to December.

Shad are doing better in the river, Ricks said, noting that recent events bode well for them. He said shad "are spawning and producing wild young," which puts them in better shape than striped bass.

"Hickory shad are doing fairly well," Ricks said. "There very well could be room for improvement, but they're pretty strong. The American shad are not doing poor, but we do think with the removal of Milburnie Dam, with some of the other things going on, that they might be able to do better in the future.

"The removal of dams such as Lowell Dam on the Little River and Quaker Neck Dam on the Neuse River has assisted American shad in accessing preferred habitats. We do have a little bit of data to suggest that since the removal of Quaker Neck Dam, the abundance of fish at Milburnie has grown. Genetically, it's all the same population from Milburnie to Goldsboro. It does seem like the Raleigh portion of the population is expanding."

In 2017, the Commission stocked 440,161 American shad fry and 14,303 striped bass in the Neuse. (The striper goal is 100,000 annually, but last year there was trouble collecting brood fish and hatchery success was poor.)

The Neuse also hosts river herring—blueback herring and alewives—as part of the anadromous run. Ricks said they have been sampling river herring since 2006 and saw a slight increase last year. They don't see as many alewives while sampling, but continued presence of alewives is a good sign for the Neuse River population.

Ricks said the Commission, along with the Division of Marine Fisheries and U.S. Fish and Wildlife Service, is formulating a new Fisheries Management Plan for striped bass. The Commission has proposed a 26-inch minimum recreational harvest size for striped bass in the Neuse and Tar rivers, but that's not the only answer. This regulation needs to be part of a larger plan to reduce mortality in inland, joint and coastal waters.

"At this point, with the ability to harvest fish in the coastal waters, it did not seem appropriate to have a moratorium in inland waters," he said. "It really all boils down to nearly 100-percent hatchery fish and really high mortality rate. Those are the facts we can't get around before recovery can happen. Striped bass mortality needs to be reduced across all fisheries for gains to be made with the Neuse River population."

THE TAR RIVER

The Tar-Pamlico River Basin is the fourth largest river basin in North Carolina and is one of only four river basins located entirely within the state. The Tar River originates in north-central North Carolina in Person, Granville and Vance counties, and flows southeasterly until it reaches tidal waters near Washington. There it becomes the Pamlico River and empties into the Pamlico Sound.

The Tar River is free-flowing from Rocky Mount Mills Dam all the way to the Pamlico Sound, approximately 125 river miles downstream. Other than some inconsistent peaks in flow due to a small hydropower facility at Rocky Mount Mills Dam, the Tar River is largely unregulated and maintains a natural hydrograph [rate of flow], which in some years provides optimum, moderate flows for successful anadromous species spawning.

The rock arch rapids fish ladder installed at Lock and Dam No. 1 on the Cape Fear River in 2012 provides fish continuous access over the dam.

The Tar hosts several anadromous species that spawn in the spring, including striped bass. Since 1996, the Commission has used electrofishing to sample striped bass each spring in the Tar, typically covering a 50-mile stretch from Battle Park in Rocky Mount downstream to the town ramp in Tarboro.

"Fish collected are counted, measured, weighed and tagged with an individually numbered internal anchor tag," District 3 Fisheries Biologist Kirk Rundle said. "The internal anchor tag is provided by [N.C. Division of Marine Fisheries] and can provide information on movement, growth and mortality. The majority of striped bass sampled are age 3 and 4 male fish in the 18-to-22-inch range. Unfortunately, few larger, older females [which are the most efficient spawners] are sampled."

The Tar, like the Neuse and Cape Fear, does not have the same spawning success as the Roanoke. Rundle explained that the number of eggs produced by a female striped bass is directly related to the size of the female. Eggs from a larger female are more resilient than those from smaller fish. Spring water flow fluctuations, sporadic water quality issues and forage availability may limit spawning success. On both the Tar and Neuse, striped bass have high mortality rates. Factors include recreational harvest, recreational release mortality, commercial harvest and commercial discard mortality. The Commission has proposed a 26-inch minimum length limit in inland waters to reduce mortality rates and allow spawning striped bass to reach larger, more productive sizes.

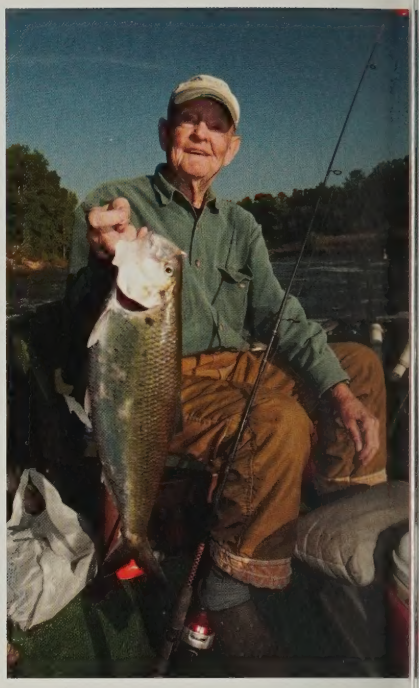
Creel surveys support the desire for increased striper and shad populations. A 2004–05 survey in the upper river showed angling efforts divided between striped bass (10 percent), shad (20 percent), largemouth bass (17 percent), sunfish (12 percent) and "anything that bites" (40 percent). A survey conducted in spring 2017 showed anglers more focused on striped bass (60 percent) and shad (40 percent), with little effort at resident species. It is apparent that Tar River anglers almost exclusively target anadromous species in the spring and turn their attention to resident species during other times of the year.

In an effort to boost natural populations, striped bass have been stocked in the Tar River since 1983. This has been a joint effort between the Commission, Division of Marine Fisheries and the U.S. Fish and Wildlife Service. Since 2010, the goal has been to stock 100,000 Phase II (approximately 8-inch) fish each year. Since 2012, only endemic broodfish collected from the Tar River are used to produce fish, with Roanoke River broodfish used prior to 2012.

"We began using genetic technology (parentage-based tagging) in 2010, in which we can archive the genetic code of hatchery striped bass produced by specific tanks of broodfish and effectively evaluate the stocking program," Rundle said. "When we conduct our routine spring sampling, a fin clip is taken from a subsample of striped bass and this is analyzed to determine if it matches hatchery broodfish or was produced in the wild, along with providing accurate ages of hatchery-reared striped bass."

Surprisingly, approximately 90 percent of the striped bass sampled are hatchery fish in the Tar River, Rundle said. "This hatchery supported fishery is not consistent with the overall goal of promoting self-sustaining striped bass populations in North Carolina coastal rivers, and is a primary reason for management actions, such as more restrictive size limits and attempts to enhance or increase natural reproduction for striped bass in the Tar River."

The shad migration, on the other hand, is a source of good news for biologists and anglers. The Commission has been sampling



CHRIS SEWARD/THE NEWS & OBSERVER

An excavator begins to dismantle the Milburnie Dam on the Neuse River below Falls Lake. Above middle: Keith Ashley and Tom Rachels, now retired, use electrofishing to sample shad around Lock and Dam No. 1 on the Cape Fear River. Below: Atlantic sturgeon also spawn in the Cape Fear River. Right: Rudolph Inman displays a female American shad he caught on the Cape Fear River.

hickory and American shad for about 20 years by electrofishing in the spring. Hickory shad normally arrive first, followed by American (or white) shad.

"American shad fishing is very popular in the Tar River near Rocky Mount and Tarboro," Rundle said. "Angler catch rates and our electrofishing data both suggest that shad populations are doing well in the Tar River. Commercial and recreational harvest is relatively low in the Tar-Pamlico Basin for American shad while catches during our sampling have been consistently high."

The sturgeon (Atlantic and short-nosed) and river herring (blueback herring and alewives) are also anadromous fish. Rundle said very little data exists for either sturgeon species in the Tar. Both are listed as endangered. The river herring have declined drastically along the Atlantic Coast since the 1970s due to overharvest, bycatch, poor water quality, predation and dams. A harvest moratorium was enacted in 2007 for all waters. Numbers are still low, but there is some hope for the future.

"We consistently observe some river herring each spring and I believe that improvement in the Tar River spawning stocks will eventually be realized due to their prolific nature, coupled with patience and continuing the moratorium for several more years or as long as necessary to rebuild the populations," Rundle said.

Looking ahead, Rundle said that researchers from East Carolina University are doing a study on hickory shad life history among Atlantic states coastal rivers, including the Tar. This research is being funded by the Commission through the Sportfish Restoration Fund. Also, the Division of Marine Fisheries is finalizing a report that looked at movement and spawning patterns of Tar River American shad, and striped bass longer than 24 inches, by using acoustic tagging technology.

THE CAPE FEAR

At 202 miles long, the Cape Fear River Basin is the largest in the state, flowing through 27 counties, while acting as the primary contributor to Wilmington's centuries-old reputation and development as a busy port community. It is the main tributary and namesake of the state's largest river basin. It is the only major river in North Carolina that flows directly into the ocean. The Cape Fear also has some unique challenges facing its anadromous species.

The Cape Fear is home to several groups of anadromous fishes: striped bass, American and hickory shad, blueback herring and a few Atlantic and shortnose sturgeon. The Cape Fear is also home to three locks and dams.

"The biggest impact on the Cape Fear, especially compared to the other coastal rivers, are the locks and dams," District 4 Fisheries Biologist Kyle Rachels said. "The three locks and dams were originally built in from 1915 to about 1935 for navigation purposes. They haven't been used for commercial navigation for about 20 years now."

To traverse the river with dams in place, boats can enter a lock, which is then either flooded to float the boat to the water level behind the dam or lowered to match the water level downstream from the dam—essentially serving as aquatic elevators for river traffic.

These navigation devices are impediments to anadromous spawning migration. In 2012, a rock arch fish ladder was completed at Lock and Dam 1 near Riegelwood. The fish ladder allows migrating fish continuous access over the dam without the need to pass fish through the lock chamber.

Rachels said the construction of the fish ladder has proven beneficial to some species,

particularly the American shad. He notes that the Division of Marine Fisheries put telemetry tags on American shad to track their movements.

"About 60 percent of the American shad who get to Lock and Dam No. 1 are able to migrate over the dam," Rachels said. "Striped bass aren't so lucky. Only about 20 percent are able to migrate over it."

In years past, the Army Corps of Engineers would fill the lock and help the fish move upstream. With the fish rapids in place, they have altered their seasonal pattern of locking fish through.

"They are at lock and dams 2 and 3, but not at 1," Rachels said. "That's something we've requested of the [Army] Corps of Engineers each year for the past couple of years since it became apparent striped bass really aren't using the fish ladder like it was originally intended, but they haven't been inclined to do so yet."

Federal guidelines released since the rock arch rapids were installed recommend slightly larger and deeper individual pools throughout the rapids, Rachels said, with the thought being that stripers will migrate as small schools and not as individual fish. The N.C. Division of Marine Fisheries will fund modifications to the rock arch rapids with money generated from Coastal Recreational Fishing License sales, and will hopefully happen in the next year or two. Rachels also said alternatives were being looked at for fish passage at Lock and Dam 2 and 3, starting with the status quo but also potentially putting a bypass channel around a dam or even a modified version of the rock arch rapid in place of a dam.

The Cape Fear has a moratorium on striped bass harvest because it shares a reproduction problem as well.

"Historically, say 100 years ago, striped bass were abundant in the [Cape Fear River]," Rachels said. "In the early 20th century, the three lock and dams were constructed. By the 1970s, [striped bass] were pretty much wiped out. So, in the early 1990s, when we started looking, most of the striped bass were actually hybrid striped bass from our stockings of Jordan Lake and other upstream reservoirs. We stopped stocking hybrids and started stocking stripers in order to start rebuilding the population so that they could begin naturally sustaining themselves through natural reproduction."

A moratorium on striper harvest was enacted in 2008. Over the past 10 years, the Commission has used genetic analysis to determine if the stripers in the river are wild or from the hatchery. Rachels said they determined that at least 95 percent of the fish are from the hatchery.

The Commission's target is to stock 100,000 Phase II striped bass in the Cape Fear each year, usually in November and December. In 2017, 154,000 were stocked.

The majority of the stripers in the Cape Fear don't migrate into the Atlantic Ocean. Instead, they live in the river and coastal estuarine waters year-round. Division of Marine Fisheries staff have tracked striped bass movement in the Cape Fear, and they see most fish spending a lot of time in the Wilmington area with periodic migrations into the northeast Cape Fear River and to Lock and Dam 1 on the mainstem Cape Fear.

Rachels said that Cape Fear American shad populations are robust and in good shape, but hickory shad are fairly rare. Although not anadromous, the flathead catfish population is strong, and catfishing is the most popular angling option, according to creel surveys. There is also a robust population of non-native spotted bass, especially in the upper stretches of the Cape Fear.

Sturgeon are present, but not in great numbers; perhaps a few hundred individuals. "We've had a couple of reports the last few years of sturgeon sightings between Lock and Dam 1 and Lock and Dam 2, so perhaps the rock arch rapids is helping them migrate upstream a little bit better," Rachels said. "There's just so few individuals, we rarely see them. It's hard to get a really good estimate on the population."

Anadromous fishes like American and hickory shad, river herring and striped bass are important social, economic and ecological resources of North Carolina.

"The North Carolina Wildlife Resources Commission staff is dedicated to the sound management and conservation of these important species," said Jeremy McCargo, anadromous research coordinator for the Commission. "Management of these species is difficult and complex because they are subject to extensive fisheries and experience varying habitats as they migrate across multiple geopolitical boundaries."

Anadromous fishes like American and hickory shad, river herring and striped bass are important social, economic and ecological resources of North Carolina.

Mike Zlotnicki is the associate editor of Wildlife in North Carolina. *He can be reached at 919-707-0175.*

HELP BEHIND THE LENS

From left: Henslow's sparrrow shot with a telephoto lens by Melissa McGaw, A macro image of a Loblolly pine cone by Mike Dunn, and a four-horned sphinx by Mike Dunn.

PHOTOGRAPHERS REGULARLY FEATURED IN *WILDLIFE IN NORTH CAROLINA* OFFER ADVICE ON OUTDOOR PHOTOGRAPHY

written by Mike Zlotnicki

One of the most frequent comments we hear from our readers is about the amazing photographs we feature in each issue of *Wildlife in North Carolina*. It's not a coincidence.

While blessed with a staff photographer in the estimable Melissa McGaw, we are also fortunate to have a wealth of talented contributors. We decided to ask them to share some of their secrets for taking outdoor pictures—from landscape to wildlife. We hope you enjoy the results.

MELISSA McGAW/NCWRC

THE SHOOTERS

MELISSA McGAW of Cary took up photography as a teenager. After college, she worked as a commercial photographer and has been with the Commission for more than two decades. (ncwildlife.org)

MIKE DUNN of Pittsboro is retired from the N.C. Museum of Natural Sciences and has been a nature photographer for over 50 years. He serves as a judge for our Photo Competition. (roadsendnaturalist.com)

TODD PUSSER of Virginia Beach is a marine biologist by vocation and a nature writer and photographer by avocation. His work appears frequently in *WINC.* His images have been published in books, calendars and magazines around the world and won awards in major international wildlife photo competitions, such as BBC Wildlife Photographer of the Year. (toddpusser.com)

KIRK PULLEN of Mount Olive is a professional photographer (a portrait specialist) who has an eye for nature photography. He is a regular competitor in our Photo Competition—he won first place in Birds and third place in Invertebrates in 2017. (kirkpullenphotography.com)

NEIL JERNIGAN of Snow Hill is a wildlife photographer and instructor. He placed second in four categories in our 2017 Photo Competition, a testament to his skill with a variety of subjects and settings. (jerniganoutdoorphoto.com)

WHAT IS YOUR BEST GENERAL ADVICE FOR ASPIRING OUTDOOR PHOTOGRAPHERS?

McGAW: Take time to learn the basics of composition. Composition is the placement of subjects within the frame and needs to be kept in mind in order to create a more pleasing image. One example of a composition rule is the 'Rule of Thirds.' It simply states that by dividing your frame into nine parts with two horizontal and two vertical lines, the most pleasing placement for your subject is usually along one of these intersections. I say usually because sometimes you may want to purposefully place your subject in the center of the frame. Knowing when to follow the rules and when to break them is important.

PULLEN: My best advice for aspiring outdoor photographers is to learn focus techniques that will help you better capture moving subjects. Focusing in a mode called "continuous back button focus" is the ideal mode for capturing moving or still wildlife. In this mode, you have one button that focuses on your subject and another button that takes the picture. Make sure your camera has one focal point that you can place on the wildlife. Don't let your camera be in a mode where it chooses what it wants to focus on or you might miss half your shots.

DUNN: My best advice for aspiring nature photographers is two-fold: Have patience and get to know your subject. When you are patient, you often see the thing you hoped for and can capture it. That is even more likely if you understand something about the behavior of the animal you are watching, or the way light can suddenly change on a winter sunrise, and can anticipate them. I try to tell stories with my photos in the hopes that I can entice the viewer to want to learn more about my subjects, and to care more about them.

JERNIGAN: Photograph for you, not for everyone else. If you're photographing what you love, it will reflect in your images.

PUSSER: Get to know your subject. If you want to photograph wood ducks, learn all you can about the natural history of the species before even setting foot in the field. If your goal is to take scenic outdoor photos, research the area you want to photograph. In this digital age, it is easy to find information online. Learning as much as you can about your subject before you pick up a camera will only help in your pursuit of good images.

WHAT EQUIPMENT DO YOU RECOMMEND WHEN GETTING STARTED?

McGAW: For anyone interested in taking up photography, there are many equipment options that will fit any budget. To capture most wildlife, you will need a long lens. Always purchase the best camera body and lens that you can afford. Take the time to become familiar with your equipment. You don't want to have the chance at the shot of a lifetime only to miss it because you are fumbling with the controls. Remember—the best camera is the one you have with you.

PULLEN: Don't get hung up on the latest and greatest gear. You can purchase great used cameras and lenses for a few

hundred dollars on yard sale websites, Amazon or ebay.

I started off with the cheapest DSLR Nikon made at the time, a Nikon D50. Then, I purchased a Sigma 70–300mm f4-5.6 lens for about $150. It was great for capturing wildlife and macro photography. If possible, find a sturdy tripod to aid you in getting the sharpest possible image. When editing your photos, I recommend using an older version of Lightroom which doesn't require a subscription fee. I found Adobe Lightroom 5 software on ebay for $6.

DUNN: It pays to invest in a good lens as it should last a lifetime with proper care (I am on my fifth Canon camera body since I went digital in 2004, but have had the same telephoto lens for all of them). Consider renting an expensive lens before buying it to make sure it can do what you want. I always shoot a lot of test frames anytime I get a new lens or camera body. Experiment with your camera settings under varying field conditions. The beauty of digital is that it allows you to quickly see your results and learn how changes in ISO, shutter speed and f-stop can impact your images.

JERNIGAN: With technology always progressing, any entry level DSLR camera is a great start. You don't have to have the most expensive camera to create beautiful images. Also, a good tripod is a must.

PUSSER: My best suggestion is to understand what subjects you want to photograph, then purchase your gear accordingly. If you want to photograph birds you will need a telephoto lens; the longer the focal length the better. If you want to take beautiful scenics then you will need a wide-angle lens and perhaps some filters, like a polarizer or a neutral density filter, and a tripod.

WHAT ARE SOME OF THE MOST COMMON BEGINNER'S MISTAKES?

McGAW: Before you press the shutter, pay attention to the background behind your subject. Is there a pole or branch sticking up behind your subject's head? You may need to move to a different position. Also do "border patrol" by running your eyes around the edge of the frame to see if there is any objectionable element affecting your composition.

PULLEN: One of the biggest mistakes beginners make is shooting in a mode where the camera decides everything for you. Learn to shoot in aperture priority mode [A mode], where you can control the depth of field instead of programmed automatic mode [P mode], where the camera chooses it. Manual mode (M mode) works well for still subjects, but it is not good for subjects that may jump up, fly or run away. You won't have time to adjust your exposures in manual mode.

DUNN: As one of the judges in the annual *WINC* Photo Competition, I have the privilege to review hundreds of submissions every year. This continually reinforces what it takes to make a powerful image—dramatic light (especially low angle lighting of sunrises and sunsets), fascinating action or behavior, eye contact, sharp focus and proper framing of the subject. Black-and-white images often highlight the contrasts and drama of a subject.

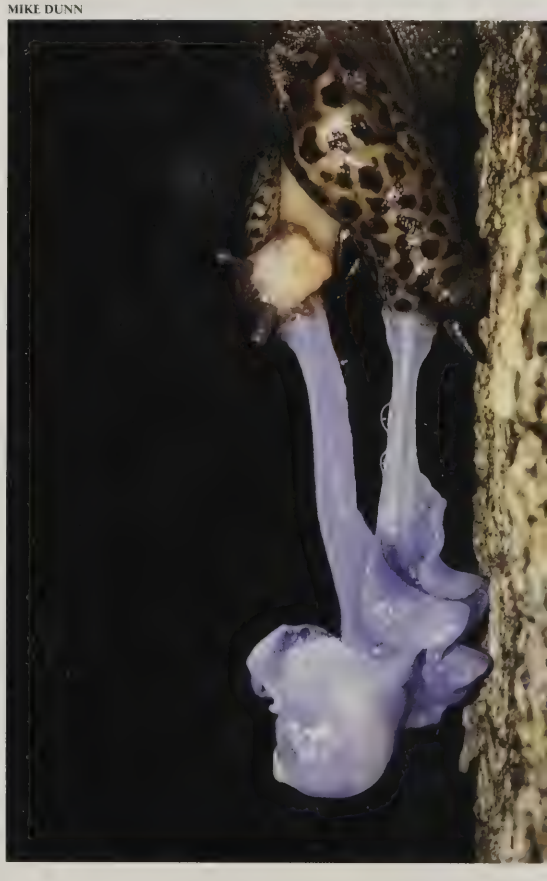
JERNIGAN: Not knowing how to utilize the equipment you have can ultimately hurt your images. With that said, worrying about gear and not concentrating on the art and craft of photography [is not a good idea].

PUSSER: The biggest mistakes I see photographers making is not understanding

KIRK PULLEN

Opposite: A macro lens helped Melissa McGaw capture this photo of a newly emerged Saint Francis' satyr. Above: A slow shutter speed and steady tripod can capture nighttime shots like this one of a lighthouse by Kirk Pullen. Below: Experience with lighting helped Mike Dunn get this shot of leopard slugs mating.

MIKE DUNN



MELISSA MCGAW/NCWRC

The soft light of the rising sun created a unique silhouette of retired enforcement Col. Kenneth Everhart during a rabbit hunt.

exposure. In this digital world we live in, it is all too common for people to just press the shutter and worry about correcting an image later in Photoshop. Do your best and try to get out of that mindset. Learn about exposure, about f-stops, about shutter speed.

HOW IMPORTANT IS LIGHTING WHEN TAKING PHOTOS?

McGAW: Light is one of the most—if not THE most—important elements in a photograph. The most ordinary subject can be beautiful in the right light.

The best times to shoot are during the "golden hours" at sunrise and sunset. The low-angled light is warmer and usually softer at the edges of the day. This is also the time when animals are most active. Overcast skies can extend the shooting hours to all day and provide soft, even lighting similar to what you achieve in your home when you cover a bare lightbulb with a lampshade.

PULLEN: Lighting is your best friend forever in photography! My advice is try to make your subject the brightest part of the scene you are trying to capture. When conditions are not ideal, bring your own light and change the scene. Learning off-camera flash can put you in control of any lighting scenario.

DUNN: Lighting is one of the most important components of a good photograph. Too harsh, and it detracts; not enough, and you miss important details. When it is just right—low angle, golden tints of a sunrise or sunset, the image can pop. For certain subjects, like wildflowers, an overcast day may be best, as it saturates the colors. A foggy or misty morning can provide the perfect black bear silhouette or spider web encased in dew. Whatever the scene, be aware of the light and work with it to get the most out of your image.

LIGHT IS ONE OF THE MOST *—IF NOT THE MOST—*IMPORTANT ELEMENTS IN A PHOTOGRAPH. THE MOST ORDINARY SUBJECT CAN BE BEAUTIFUL IN THE RIGHT LIGHT.

JERNIGAN: How an image is lit will determine the overall mood and atmosphere of the photograph. Knowing how to manipulate the different types of light will either make or break your photograph. Lighting is so important that you can have one of the best subjects, in bad light, and it will ultimately make it a bad photograph. While having a mediocre subject, in great light, can make it a great photograph.

PUSSER: Light is often the difference between a good photograph and a poor one. Work hard to understand light and how it affects your exposure. For example, how will your camera expose something like a white snow goose standing in the middle of a dark winter field? How does overcast light affect the look and mood of your subject? As you mature as a photographer, consider adding flash to your arsenal of gear. It will open up a new world of possibilities.

WHAT IS ONE OF YOUR BEST TIPS FOR PHOTOGRAPHING PEOPLE, LANDSCAPES AND WILDLIFE?

McGAW: In most situations you want to be eye-level with your subject. For small animals that means getting low yourself, sometimes in a prone position. Knee pads can be a help in these situations.

Blinds are good tools to have for certain situations. There are several options on the market, from collapsible-frame blinds to soft camo cloth models that drape over you and your tripod.

A tripod is one of those pieces of equipment that can be a pain to carry on long hikes but is absolutely essential in many situations. To support a long prime lens or to hold your camera steady during long exposures while capturing a mountain stream are just two examples.

Photography subjects are as close as your backyard. How often have you come across a beetle while working in your garden? Take some time to get out and explore your county and state parks, as well as wildlife refuges that provide an abundance of opportunities.

PULLEN: A great tip for shooting people is to use a reflector. You can buy reflectors, but a much cheaper solution would be a white piece of poster board. Hold it up to the chest of the person and shoot a head shot while in some shade. You will get great catch lights in the eyes!

When shooting landscapes, try to think in 3D. Find something interesting in the foreground and background that will add to your subject in the middle.

When shooting wildlife, it is hard not to get excited at the prospect of getting that winning shot. My advice is to take slow steps,

stay quiet, and be patient. Study your subject and find their habits. It's amazing how repetitive the behavior of people and animals can be.

DUNN: A growing concern is the disturbance of wildlife by overzealous photographers. Yellowstone National Park recently released a new media campaign with the catch-phrase, "Zoom with your lens, not with your feet," to try to reinforce the idea that you should not approach wildlife too closely. A good general rule of thumb is that if the animal changes its behavior in reaction to you, you are too close. Remember that your vehicle is a wonderful photo blind when visiting parks and refuges.

JERNIGAN: A great image tells a story, so make sure you can clearly distinguish your subject. Which leads to making sure your focus is placed on what you intend the viewer to look at.

PUSSER: More photos are taken in a single hour today than at any point in our history. With high quality cameras in just about every phone, millions upon millions of images are uploaded every day to Facebook, Instagram, Flickr, Snapchat, Twitter, etc. You can rest assured that no matter the subject, it has been photographed many, many times before. To stand out from the crowd, try and tell a story with your photos. Don't just settle for a portrait of a deer or an image of a beautiful sunset. Try and create an image that will hold a viewer's attention longer than the second it takes to swipe it away on your Facebook feed.

CAN YOU SHARE A CLOSING THOUGHT TO HELP READERS TAKE BETTER PHOTOS?

MCGAW: In all situations dealing with wildlife, practice wildlife ethics. Ethical wildlife photography strives to minimize the impact and disturbance on the wild animals we are pursuing with our cameras. We are out there to document not to harass.

There are too many stories from professional photographers about being set up on a subject with telephoto lenses and having someone with a smart phone or an iPad walk in front to try to get a photo. Not only is that person ruining the situation for the other photographers, in the case of a bear or an elk, it is dangerous. Remember to be courteous to other photographers.

PULLEN: I encourage readers to enter photo contests and subscribe to *Wildlife in North Carolina* magazine. That's how I got my start!

DUNN: Don't let the camera control the experience, don't just look for "the shot" as the total reason for being there. Become the photographer that knows your subject, does no harm, and shares images to help others appreciate the wonders of nature. Learn to see and appreciate the world around you, and you can make beautiful memories and stunning photographs.

JERNIGAN: Time in the field is essential. The more you're out photographing, the greater the chance you'll have of capturing that once in a lifetime moment. Becoming a great artist and photographer doesn't happen overnight. Patience is key and practice makes perfect.

PUSSER: Just keep practicing. The more you shoot the better you will become. Learn all you can about your subjects. Make notes. Pay attention. Don't be afraid to experiment. Never harm your subjects. Leave only footprints. Have fun.

Mike Zlotnicki is the associate editor of Wildlife in North Carolina. *He can be reached at 919-707-0175.*

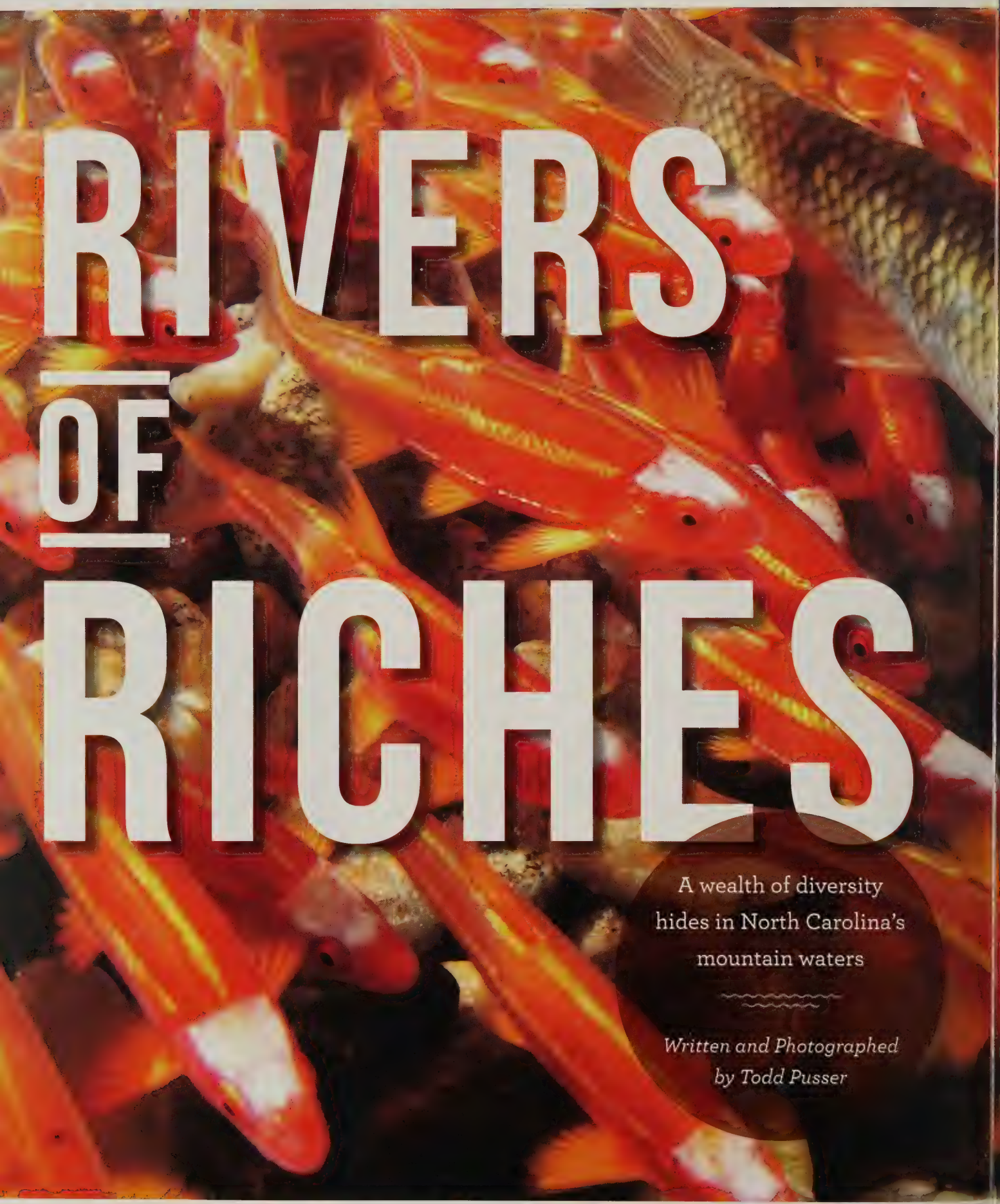
MIKE DUNN

MIKE DUNN

Top to bottom: A stinging rose caterpillar is shown with its shed skin. A leafcutter bee carries a leaf fragment to its nesting hole. A wide-angle lens was used to shoot this picture of an Eastern coachwhip's head, while a telephoto lens was used to capture a black bear in a tree.

TODD PUSSER

NEIL JERNIGAN



RIVERS OF RICHES

A wealth of diversity hides in North Carolina's mountain waters

Written and Photographed by Todd Pusser

THE state of North Carolina is truly an aquatic state. Seventeen river basins flow within its borders. Over 20 natural lakes occur in the Coastal Plain, more than our neighboring states of Virginia and South Carolina combined, while hundreds of manmade lakes, ponds and reservoirs dot the landscape. Nearly 300 miles of shoreline borders the Atlantic Ocean. Water is everywhere in North Carolina. This series of three articles will examine the incredible diversity of life that call our state's waters home and will show aspects of this element from a perspective few see—from beneath the surface.

The sudden rush of cold water down the back of my wetsuit momentarily takes my breath away. Adjusting my facemask and snorkel, I float quietly over a large mound of golf-ball sized rocks standing like a miniature ancient pyramid over the surrounding sandy bottom. The words of North Carolina Wildlife Resources Commission Biologist Stephen Fraley echo in my mind: "Keep in mind that you are hunting Easter eggs and I wasn't the one who hid them. You are going to have to look around a lot to find them and cover long reaches of streams to find what you want."

For three days, I have done just that, driving hundreds of miles, wading and snorkeling countless streams, searching for a rock pile just like this. Not just any run-of-the-mill rock pile, mind you, but one swarming with a mass of brightly colored fish that instantly brings to mind a vibrant tropical coral reef. This is not the Caribbean. I am snorkeling the waist-deep waters of a small stream high up in the North Carolina mountains near the town of Cashiers. Below me is one of the greatest wildlife spectacles that this state has to offer. I have finally found my Easter egg.

With heads pointed into the current, hundreds of yellowfin shiners swarm over the rock mound, an underwater tornado of bright oranges, yellows and reds. This aggregation of breeding minnows, affectionately called "liquid sunshine" by some ichthyologists, has gathered over the rocky nest of another much larger species of minnow, the bluehead chub, in an annual rite of spring. The chub, stout and nearly 7 inches long, straining the very definition of what it is to be a minnow, has spent hours upon hours lifting rocks with its mouth and piling them in a neat pyramid, also known as a chub mound, near mid-channel of this stream.

Nestled within the rock mound are hundreds of eggs, laid at an earlier time by female chubs. The male chub constantly mouths the rocks, picking them up gently and placing them back down on the mound, something he will do for many days. The brilliant shiners, dull and brown for most of the year except during breeding season, swirl over him in a chaotic ballet, themselves releasing milt and eggs into the rock pile. The chub, by constantly moving stones and creating a mound elevated above the streambed into the water column, has created the perfect environment for nurturing its eggs and those of the shiners. The rocks provide the eggs with shelter from predators and the height of the mound exposes the eggs to the current that flushes the nest free of silt and sediment.

"Research has shown that yellowfin shiner will not spawn in the absence of bluehead chub, the species relies entirely on the chub for successful reproduction," said Brandon Peoples, whose lab at Clemson University works to understand the relationships of fish and the habitats that sustain them. "But that is only half the story. This past summer we conducted a large experiment and found that chubs may need yellowfin shiners as much as shiners need the chubs. Their relationship is mutually beneficial to each other."

An Aquatic Candy Store

The Appalachian Mountains—extending from Virginia, through the Carolinas and down to Alabama—are blessed with an abundance of creeks, rivers and streams. Yet few among us take the time to stop and really appreciate them. We drive over them every day, on old blacktop roads and interstates, rarely giving them a second glance. We cast fly lines into them with hopes of catching a trout for dinner. On hot summer days, we float their currents on inner tubes, feet dangling in cool waters. To the uninitiated, a mountain stream or creek

▶▶

Opposite top: When mating, a male chub, with white tubercles on his head, arches his body in a semicircle to clasp a receptive female, seen here arching her head upward. Opposite bottom: A male bluehead chub (*Nocomis leptocephalus*) works tirelessly moving small rocks around his nest in hopes of attracting a female.

might appear empty; nothing more than shifting rock and sand sculpted by flowing water. Yet, for those who look closely, just beneath the surface, an incredible world of riches awaits.

In these waterways, shaped over eons of time, life has achieved a staggering level of diversity unrivaled by any other temperate region in the world. Over half of the 850-plus species of freshwater fish found in the United States and Canada call these waters home, as do more than 600 species of freshwater mussels and snails, 250 species of crayfish and the planet's greatest diversity of salamanders.

"The Appalachian highlands are a virtual candy store for those who study and seek to understand the diversity of fish and the roles they play in the ecology of their stream homes," says Wayne Starnes, retired curator of fishes for the North Carolina Museum of Natural Sciences and the co-author of the book "Fishes of Tennessee."

In the North Carolina portion of that "candy store," perhaps no other fish stand out more than the family of bottom dwelling perches known as darters. Lacking swim bladders, darters are negatively buoyant and regularly rest on the bottom of streams, balanced on their front fins and tail. When threatened by a predator or seeking prey, they dart away in a flurry of tail strokes, hence their name.

Considered the warblers of the fish world with their abundance of flashy colors, darters have achieved an extraordinarily high level of speciation across North America. At least 40 species are found in North Carolina, of which more than half occur in mountain waters. Among the most striking members of the clan are tangerine darters, whose brightly colored orange-red males reach lengths of 7 inches. "Tangerine darters are very personable fish," said J.R. Shute, co-director of Conservation Fisheries, a nonprofit organization dedicated to breeding and reintroducing endangered native fish throughout the Southeast. "If you stay very still in the water, they will come right up to you to check you out." I noticed

With mottled coloration, a box-shaped head and large lips used for overturning rocks and stirring up the bottom for small aquatic insects, the Northern hogsucker (*Hypentelium nigricans*) is perfectly adapted for life in mountain streams.

▲ Above, left to right: Each spring, Appalachian creeks and rivers explode with color as tangerine darters (*Percina aurantiaca*), greenhead shiners (*Notropis chlorocephalus*) and crescent shiners (*Luxilus cerasinus*) come together to spawn. Below: A bright male gilt darter (*Percina evides*) and a crayfish (*Cambarus sp*) rest on the bottom of a small creek near Brevard.

this while snorkeling the Pigeon River near Canton last summer, where upon entering the water I found myself immediately surrounded by several tangerine darters. Each time I pushed my hands off the bottom, the darters rushed over, like eager puppies, looking for microscopic food stirred up by my fingers buried in the sand.

It's not just fish that make these streams so special. Our state's waters serve as the last stronghold for North America's largest amphibian, the hellbender. Living entirely underwater and reaching lengths of 2 feet on a diet of crayfish and small fish, these Godzilla-like giants sport huge flat heads, wrinkly skin and large toes for gripping rocks in strong currents. "Hellbenders are a vital link to our Appalachian natural history and are indicators of healthy river ecosystems," North Carolina Wildlife Resources Commission Biologist Lori Williams said. "I, personally, would rather not swim, fish, paddle or play in any stream that doesn't have a healthy hellbender population."

It may seem hard to take seriously creatures with names like purple wartyback, Carolina heelsplitter, Appalachian elktoe and Tennessee pigtoe. Yet these mountain freshwater mussels, just a few of the more than 60 species found across the state, are among the most important creatures inhabiting our local waters by providing ecological and economic benefits for all life—including humans. By acting as living biological water pumps, mussels clean waters by filtering out algae, bacteria and detritus. Over their lifespan, which can exceed 100 years, mussels clean millions of gallons of water at no cost to humans.

Waters Worth Protecting

An old truism states that "the more you have, the more you have to lose." There is more than an element of truth to that statement when it comes to our state's creeks and streams. Water, earth's most precious commodity and sustainer of life, is also its most neglected resource. We tend to be shortsighted in our relationship with aquatic resources, not realizing or understanding that the consequences of our actions today

A battle-scarred adult male hellbender (*Cryptobranchus alleganiensis*) crawls slowly across the bottom of a shallow stream. North Carolina waters serve as the last stronghold for this declining amphibian giant.

have meaningful impacts on the quality of the life for our children and their children of tomorrow. Who among us takes the time to think about where the water comes from each time we turn on the kitchen faucet?

The creeks, rivers and streams of the Appalachians face a multitude of challenges from an ever-increasing human population. Dams have dramatically altered habitat, disrupted fish migration, restricted water flows and impacted water quality. Sedimentation and pollution from mining, agriculture and urbanization have provided additional strains to aquatic diversity.

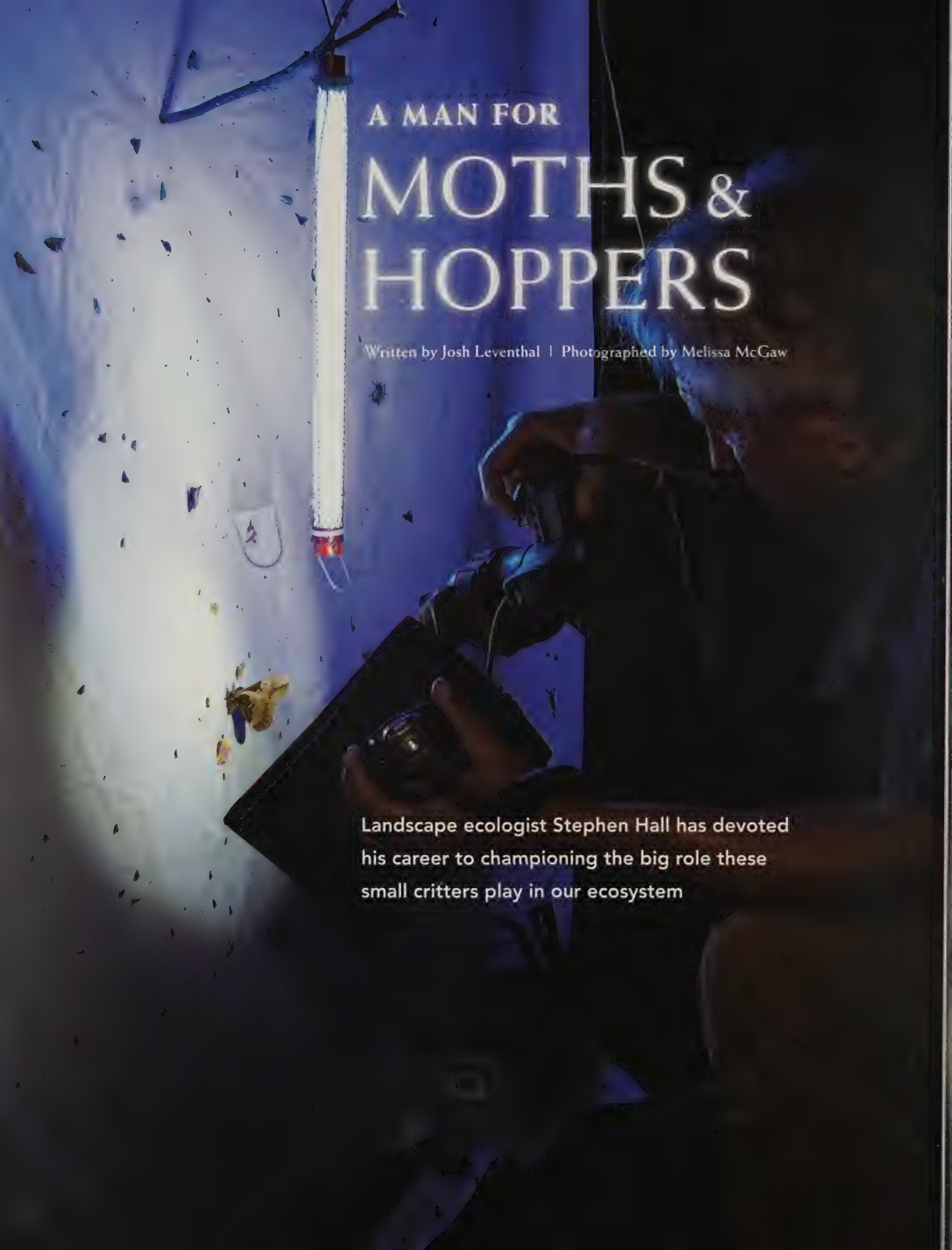
In his 1849 self-published book "A Week on the Concord and Merrimack Rivers," acclaimed writer and philosopher Henry David Thoreau questioned "who hears the fishes when they cry?" upon witnessing the changes occurring to his beloved streams at the onset of the Industrial Revolution. Over a century and half later, his words still hold relevance for Appalachian waters, where over 30 percent of the fish species and 70 percent of all mussel species are threatened with extinction.

Back at the chub nest, as I continue to watch the underwater fireworks show, I feel something bump me in the chest. Thinking it is just one of the fish, I keep my camera focused on the adult male chub. As the bumping continues, I look down and to my surprise find a large Northern water snake resting just beneath my wetsuit. Suddenly, the snake lunges out from underneath me and dives into the swirling mass of colorful fish. With a quick strike, it grabs a shiner and takes off upstream.

The action is so fast and so unexpected that I completely miss the shot. Despite the numbing cold water and lack of a photograph, I lift my head out of the water and chuckle into my snorkel at having witnessed a behavior few have seen. The natural wonders beneath our state's rivers, so often overlooked and rarely appreciated, never cease to amaze. ➖

Todd Pusser is a marine biologist and freelance writer whose articles and photographs frequently appear in Wildlife in North Carolina.

Above: A musk turtle (*Sternotherus sp.*) crawls along the bottom of the Pigeon River near Canton. Little is know about the distribution and abundance of mountain turtles compared to other reptile species. Below: A queen snake (*Regina septemvittata*) forages for freshly molted crayfish in a shallow creek.



A MAN FOR MOTHS & HOPPERS

Written by Josh Leventhal | Photographed by Melissa McGaw

Landscape ecologist Stephen Hall has devoted his career to championing the big role these small critters play in our ecosystem

Stephen Hall walks carefully but with a purpose along a dirt road cutting through Duke Forest in Chapel Hill on this late September evening. He is **in his element, conducting a moth survey—like he has done countless times—when he pauses and turns to his guests. He lifts one finger and points, as if to ask, "Did you hear that?"**

Chances are you're not hearing what Hall hears. Few do.

"That katydid sounded like it landed right on the sheet," Hall said, referring to the cloth hanging in front of a 15-watt black light that attracts moths and other insects to his viewing station of sorts around the bend. He slowly stalks the sound, flashlight in hand. "It's kind of hard to locate these guys."

Yet that is what Hall has done during a long and distinguished career as a landscape ecologist and invertebrate zoologist. Not only has he found insects far less common than the katydid—Hall discovered a rare Venus flytrap moth and led the survey that resulted in the Saint Francis satyr being listed as endangered—but he has also shined a light on the habitat needs and conservation strategies for all sorts of insects. A self-described champion of moth and grasshopper conservation, Hall's work during a 25-year career with the Natural Heritage Program resulted in methodology to assess landscape integrity and terrestrial habitat quality, including a standard for conducting controlled burns to manage insect habitat. He was honored with the distinguished Thomas L. Quay Wildlife Diversity Award by the N.C. Wildlife Resources Commission in August 2016.

All the while, Hall has remained passionate about his subject matter—the moths, grasshoppers, crickets and other small creatures whose important role in our ecosystem he believes is often overlooked. That passion is on full display this evening in Duke Forest. While following the yet-to-be-seen katydid, Hall describes other sounds he hears among the cacophony of insect white noise. There's the Japanese burrowing cricket—"zip, zip, zip, zip, zip," he says, imitating its call. He picks up a raspy, clicking sound, which he says belongs to a greater angle-wing katydid. "Tink, tink, tink" goes the ground cricket, which he notes is different than the single pulse of a bush cricket.

Finally, he finds what he's looking for. "Ah, here's the katydid," Hall says, shining his light on the grasshopper that landed just a few feet from where he had first estimated. He goes on to describe its call. "A true katydid has three to five pulses. It sounds like it's saying 'kat-y-did.'"

Hall's encyclopedic knowledge of all things insects is impressive, and not only to the uninitiated. Linda Pearsall spent over 20 years as director of the Natural Heritage Group, often overseeing many of Hall's studies and projects. She is equally enamored with his critter knowledge.

"Walking through the woods with Steve is a wonderful experience because he sees things the rest of us don't notice," said Pearsall, who won the Quay Award in 2014. "He knows what kind of insects to expect in the forest, where to look to find them and how to listen for them. He sees more detail than most of us realize is there. It is almost like second nature to him. He hears the birds and he thinks about what is there to be eaten. Most of us just see a bird. Steve sees it and thinks about what trees are there and what insects are there that are giving the bird its habitat. He thinks about things at

Opposite: Stephen Hall uses a black light to attract a variety of moths to a sheet he has set up during a night survey in Duke Forest. Above: Hall documents insects not only by sight but also based on their calls, and he has recordings of all sorts of critters, including grasshoppers.

In retirement, Stephen Hall has helped launch the website, nc-biodiversity.com, as part of the North Carolina Biodiversity Project. He seeks to document the entire moth fauna of North Carolina.

Penitent Underwing

a great level of complexity and he tries to share that."

Hall has made a career of sticking up for the little guys. He recognizes that insects are largely ignored or considered pests. Hall points out, however, that they are critical to our life cycle because they play a key role as either decomposers or pollinators.

"Insects are the main food for our songbirds. Bats, small mammals, fish—they are all feeding on insects," Hall said. "Without insects, we wouldn't have all of these species that we do like to have in our landscape. They are the most diverse group of animals by far; there are more insects than any other animal. If you are interested in wanting to conserve diversity, you would want to start with the insects, not ignore them. Because they are such finely tuned habitat specialists, they offer a lot of information to anyone trying to monitor ecosystem health and manage native ecosystems. How you can ignore all of this information that insects are providing is astounding, but that has been the pattern."

Meet the Mothman

Hall got his start in insect research the same way many others do: with an active childhood. As a youngster, he chased butterflies and brought critters home to his terrarium. However, unlike most kids, Hall got an early exposure to higher education and scientific research. He spent his early years on the campus of Stanford University, specifically around the Stanford Research Institute where his mother worked as a secretary while his father pursued a graduate degree in English. There he got a peek into the formal study of insects.

"There were a lot of labs around. I could see into these buildings, see things like terrariums," Hall said. "I was intrigued by everything going on around me. I got a book on insect photography given to me by one of the biologists at Stanford Research Institute."

That early interest sparked a passion in Hall that eventually led him to the University of North Carolina at Chapel Hill for a doctorate in biology with a focus on animal behavior. He studied vertebrates more than invertebrates, and focused his thesis on the movement patterns of box turtles. He attached spools of threads to their shells so that he could track their movements. His advisor, Haven Wiley, recalls it as both a fascinating study and "the longest dissertation that I have ever received."

> "If you are interested in wanting to conserve diversity, you would want to start with the insects, not ignore them.

"He tracked them and got a complete record of where the turtle had been over weeks or months," Wiley said. "He found the turtles lived in rather fixed areas, then the adults would take these tremendous egg-laying trips. They would go a kilometer or more to where they wanted to lay their eggs and then return to where they had begun."

This realization would ultimately influence how Hall approached conservation throughout his career. Hall discovered that habitats cannot be isolated if the goal is to conserve a species, but rather they must be connected to similar habitats. This belief in wildlife corridors is true for creatures large and small, and became the basis for much of his research.

"Small, isolated preserves are not very viable," Hall said. "They can persist only if they have some connection between them, so if populations [of a species] get lost, they can connect to a habitat near them. My idea was not just to change the focus on sites, but make sure they are viable in the long run if they are connected in one way or another. I'm still working on that, working on a plan for landscape level conservation."

This belief took shape early in Hall's career when he conducted inventory surveys of Chatham, Durham and Orange counties. "In those kind of inventories we did stress the fact that a lot of the sites were within the same stream basins, and it was the

Ailanthus Webworm

Delicate Cycnia

Eastern Panthea

Suzuki's Promalactis

Grass-veneer moth

Rosy Maple Moth

Bicolored Angle

Tulip-tree Silkmoth

connections between them that gave them more viability."

In 1991, after joining the Natural Heritage Program, he led a study of insects in longleaf pine preserves to determine how the management of those preserves was affecting insect populations. It was during this project in Pender County that he discovered a population of Venus flytrap moths, which he said was the first documented finding of that species since the 1700s. While working with Dale Schweitzer, the chief entomologist for the Nature Conservancy at the time whom Hall described as his mentor, he would discover that the fire-dependent species do not immediately return to a habitat that had been burned, but rather come from a place that had not been burned.

"Even though they are dependent on fire-maintained habitats, they have no means of surviving a fire on site," Hall said of Venus flytrap moths. "That discovery really provided a lot of information about how to manage for the insect populations. You don't want to burn all of your habitat at the same time. You need to take pains to set aside some areas that can serve as a refuge."

Insects "are the most diverse group of animals by far; there are more insects than any other animal," Stephen Hall said. Examples of that diversity can be seen in the cecropia moth (right), copper underwing (left), lesser angle-wing katydid and stinging rose caterpillar.

This would become a model for how to conduct controlled burns, particularly if managing for insects. He notes that most fire-dependent animals, like the red-cockaded woodpecker, and many plants have ways to survive a fire. Most insects do not. So his recommendation was to divide an area into thirds and only burn one portion a year.

"Red-cockaded woodpeckers always survive a fire. They can fly away, and their nestlings are up high enough that they will survive a fire. They're not as sensitive to a fire as the insects are, and the plants aren't either. If you look at insects, you see something much different. They are more sensitive to the timing and the spacing of a fire."

Passion Projects

Like the insects he studies, tracking Hall's movements can be a bit overwhelming. The list of projects he has been involved in seems endless.

In the mid-1990s, Hall led a team to monitor spraying being done to combat the Asian gypsy moth, which had been transported on military equipment returning from the Gulf War and had been found in the Wilmington area near the Sunny Point terminal. While concerned about making sure Asian gypsy moths did not get established in North Carolina, Hall led a team to ensure the control efforts had as little impact as possible on natural areas.

"Steve changed the way that project was done, and because of it, we didn't lose a lot of native species from our natural areas," Pearsall said. "We got rid of the Asian gypsy moth, so obviously it was an effective treatment, but we did not have a lot of collateral damage."

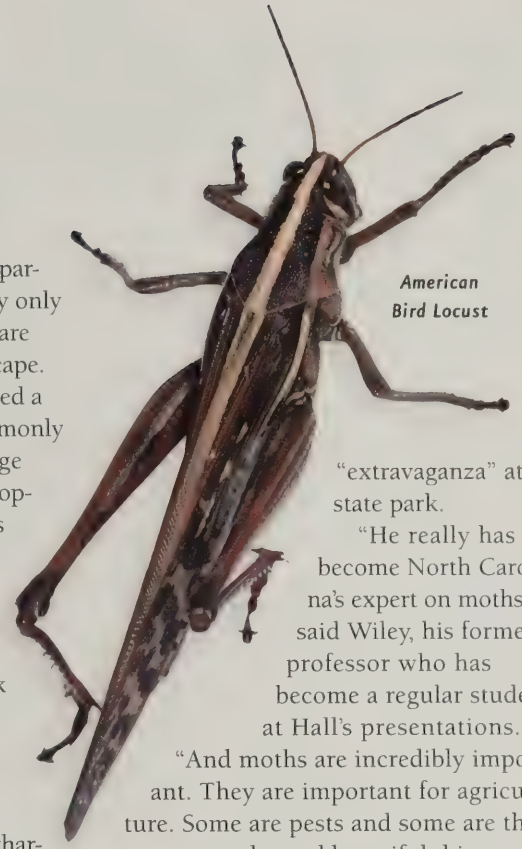
Hall conducted a survey of the Saint Francis satyr that resulted in the butterfly found only in Cumberland and Hoke counties being listed on the endangered species list. Hall tracked the butterfly on Fort Bragg, where the species that prefers fire-disturbed wetlands can be found in the artillery zones used for training.

Recently, Hall has been studying a particular species of moth that is typically only found near monadnock rocks, which are sharp peaks or high points in a landscape. The large, roughly 2-inch moth is called a *Lytrosis permagnaria* and is most commonly found in the Uwharrie and Blue Ridge mountains, but Hall has found a few populations in the Piedmont. This includes spots in Duke Forest and Occoneechee Mountain in Hillsborough, each of which has monadnock rocks. One similarity between the locations has been the presence of rock chestnut oak trees, which Hall hypothesizes is not a coincidence.

"What I wanted to know is if the fauna is similar [in the Piedmont locations] to what you find in the Uwharries, where there are more monadnocks," Hall said. "How do they maintain their populations when they are so widely scattered?"

No Rest for the Retired

Hall officially retired from the Natural Heritage Group in 2014, but he has hardly been taking it easy. "When I left the program, I didn't lose interest in conservation," he said succinctly. He continues to conduct surveys and study the insects he dedicated his career to—including the Venus flytrap moth. He teaches courses at the North Carolina Botanical Garden in Chapel Hill and he hosts several "moth nights" each year—during which he puts out black lights and bait traps to identify and discuss the variety of moths that stop by. Hall's next moth night is scheduled for June 16, and he is working on scheduling a moth viewing "extravaganza" at a state park.



American Bird Locust

"He really has become North Carolina's expert on moths," said Wiley, his former professor who has become a regular student at Hall's presentations. "And moths are incredibly important. They are important for agriculture. Some are pests and some are the most spectacular and beautiful things we have in North Carolina."

Keeping Hall particularly busy is his involvement in the North Carolina Biodiversity Project, in which he is partnering with longtime colleague Bo Sullivan on a website with the goal of documenting the moth fauna of North Carolina—roughly 4,000 species. The website, nc-biodiversity.com, launched last year and features identification records of 2,700 moths. It allows other biologists to upload photos of moths for Hall and Sullivan to identify.

> "Moths are incredibly important. They are important for agriculture. Some are pests and some are the most spectacular and beautiful things we have in North Carolina."

"His passion for clarifying or documenting these insects that most people don't care about is amazing," Pearsall said. "Creating that information and compiling it in one place that is easily accessible is huge. It will be a big benefit as we start to see habitats change over the coming decades."

Josh Leventhal is the editor of Wildlife in North Carolina. *He can be reached at josh.leventhal@ncwildlife.org.*

WILDLIFE IN NORTH CAROLINA 2018 PHOTO COMPETITION

WILDLIFE IN NORTH CAROLINA MAGAZINE IS PROUD TO ANNOUNCE THE 14TH ANNUAL INSTALLMENT OF OUR POPULAR AND SUCCESSFUL PHOTO COMPETITION. Last year, almost 1,500 images were entered. This year, your winning photo could be published on the cover of this magazine. Adult photo competition entrants must be subscribers to *Wildlife in North Carolina*. Photographers in the two youth categories (13–17 years old and 12 and under) may enter free of charge.

The cost of the prizes and the prints sent to winners has necessitated that the magazine join the ranks of many other photo contests and charge an entry fee.

The *Wildlife in North Carolina* Photo Competition aims to encourage people to participate in nature photography, thereby fostering greater understanding and appreciation of North Carolina's wildlife and wild places. Winning photographs will be published in the January/February 2019 issue of *Wildlife in North Carolina*. Thanks to our exhibition sponsor, JW Image Company of Raleigh, the winners will also be exhibited at the Museum of Natural Sciences and at other science museums and wildlife education centers across the state in 2019.

The N.C. Museum of Natural Sciences, our founding partner, is a fantastic place to learn about North Carolina's wildlife and wild places through its exhibits and classes. North Carolina's outstanding state parks are ideal places to photograph wild animals and wild landscapes. Visit ncwildlife.org for more information about the competition. Then get outside and show us your best nature photography.

CHARLES ENGLISH

Twirling steel wool set on fire, and photographing it with a slow shutter speed, creates this unusual visual at Fort Fisher.

2018 COMPETITION RULES

WHO MAY ENTER

Amateur and professional photographers, except for employees of the N.C. Wildlife Resources Commission, the N.C. Museum of Natural Sciences, and their immediate families (children, siblings and spouses). Adult entrants must be subscribers to the magazine.

WHAT TO ENTER

Photos will be judged in 10 categories:

Birds

Mammals

Reptiles and Amphibians

Invertebrates

Wild Landscapes: The peaks, valleys, plains and beaches of North Carolina.

Wild Plants and Fungi: Wild-growing plants only, including their flowers, leaves, fruits and other parts. Absolutely no cultivated plants will be accepted.

Outdoor Recreation: Show how people interact with North Carolina's natural world through activities that are inextricably linked to nature, such as hunting, fishing, hiking, rock climbing or canoeing.

Animal Behavior: Anything animals do, from everyday activities to interactions with other animals to unusual behavior.

Youth Photographer, 13–17: Any of the above subjects, shot by photographers under 18.

Youth Photographer, 12 and under: Any of the above subjects, shot by children 12 and younger.

Photographs must have been taken in North Carolina no earlier than Sept. 15, 2014.

You must declare on your entry form if your photograph is of an animal in captivity, such as at a zoo, nature center or rehabilitation facility. Please do not enter photos of animals that are both captive and non-native to North Carolina (for example, polar bears or lions at the N.C. Zoo).

No pets or domestic animals will be accepted, with the exception of animals participating with people in outdoor recreation (for example, hunting dogs or riders on horseback).

Please do not harass wildlife in an attempt to photograph it.

Manipulation of images, either film or digital, should be limited to conventional darkroom techniques or basic sharpening and cropping. Images should contain only the subject matter as originally seen through the viewfinder. Multiple exposures, digitally stitched photos, high dynamic range images and photos containing any manipulated or added content will not be accepted and should not be entered.

Entries may not contain any text aside from that contained in the subject matter. Date stamps, signatures and trail camera information are not permitted, regardless of whether they are added during or after the image is photographed. Original images may be cropped to eliminate date stamps or other text.

An entrant must hold all rights to a photograph. Photos previously published or pending publication, or that violate or infringe upon another person's copyright, are not eligible. Please do not infringe on the rights of property owners in an attempt to photograph animals.

HOW TO ENTER

Visit ncwildlife.org, click on the Photo Competition link, and then click the Enter a Photo link to submit a photograph. Only JPG files smaller than 2 MB will be accepted for upload. Upload your photo using the online entry form on the website. Repeat this process for each photo entered. Entrants may submit a maximum of two (2) photos per category.

The competition begins at 8 a.m. on Friday, June 1, 2018. Entries must be uploaded by 5 p.m. on Saturday, Sept. 1, 2018. Entrants may verify receipt of entries by checking ncwildlife.org and clicking the Photo Competition link to view a text list of all entries.

An image may be entered in only one category. For instance, if a photo of a preening wood duck might fit in Birds or Animal Behavior, you must choose the one category in which you want the image to compete.

Entrants in the youth categories must be the appropriate age for the category entered on the closing date of the competition. Once a youth photographer has entered two photos in the proper youth category, they may enter other photos in any other categories they wish.

PRIZES

All winners will be published in the January/February 2019 issue of *Wildlife in North Carolina* and exhibited at the N.C. Museum of Natural Sciences. Winners will also receive a print of their winning entry from JW Image Company.

Grand prize: Your photo published on the cover of the January/February 2019 issue of *Wildlife in North Carolina* magazine, plus $200.

First place, all categories: $100.

Second place, all categories: $75.

Third place, all categories: $50.

JUDGES

Winners will be selected by a panel comprised of staff of the N.C. Wildlife Resources Commission, the N.C. Museum of Natural Sciences and professional wildlife photographers.

THE FINE PRINT

By entering the *Wildlife in North Carolina* 2018 Photo Competition, entrants grant all sponsors the right to publish and use submitted photographs in print or electronic form to promote the competition. Reproduction of entries will include the necessary photographer credit.

Entrants agree that if their submission is selected as a winner, they grant all sponsors the right to display their photograph(s) at venues including but not limited to the N.C. Museum of Natural Sciences. Exhibition of entries will include photographer credit.

Entrants will be asked on the online entry form if their photo was taken in a North Carolina state park. All such entries will be provided to the N.C. Division of Parks and Recreation for possible usage in public information/promotional materials, park displays or agency press releases to various media outlets. Any such usage will include the necessary photographer credit.

Winners will be required to provide original source material—slides, high-resolution digital files or negatives—for reproduction in the magazine and for exhibition prints. Original digital files of winning photos must be accompanied by a color print of at least 4x6 inches.

Wildlife in North Carolina staff will determine entry eligibility.

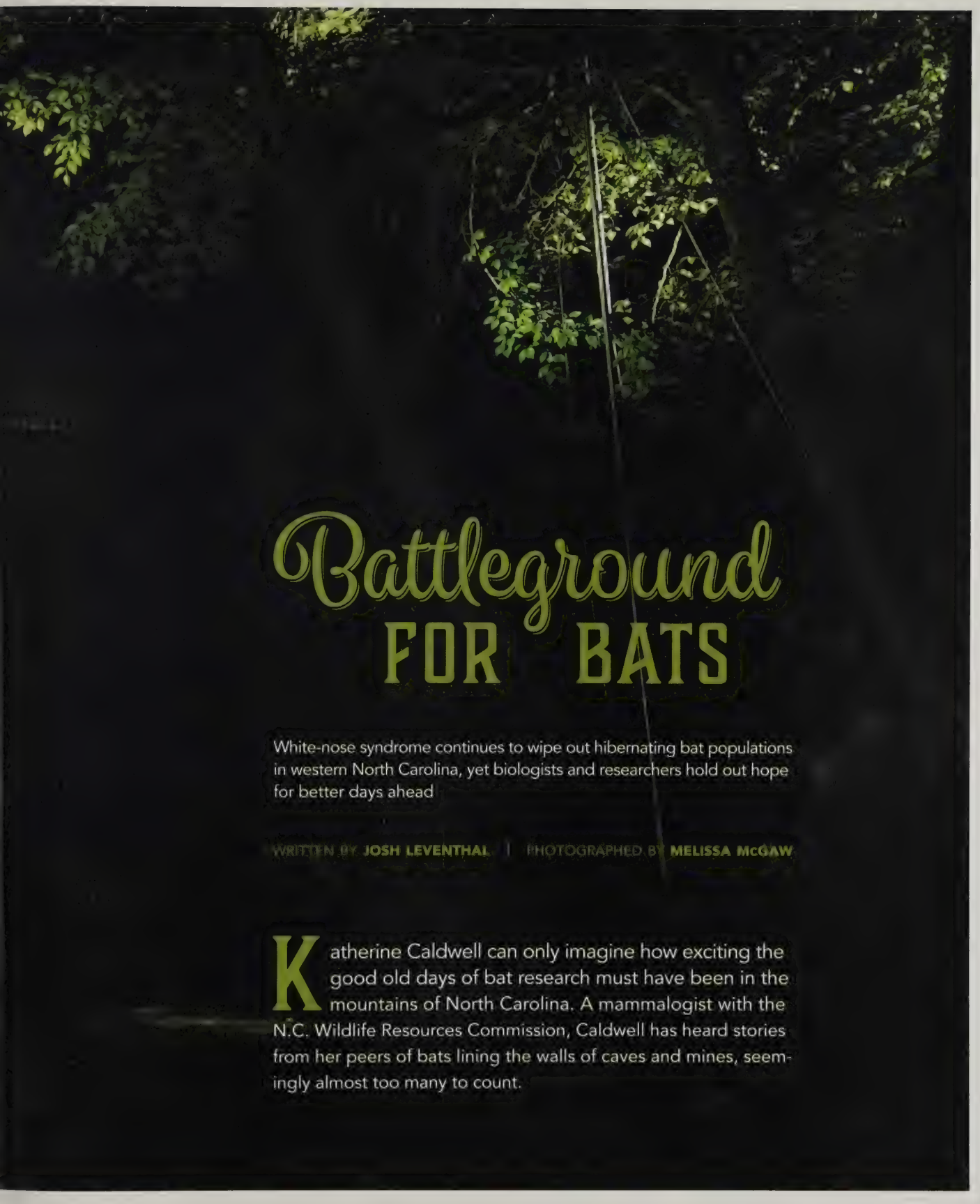
QUESTIONS?

Please do not call about entries. Send questions to **competition@ncwildlife.org.**

Enter online at ncwildlife.org.

Grab your camera and good luck!

N.C. Wildlife Resources Commission Mammologist Katherine Caldwell and Wildlife Technichian Joey Weber inspect a mist net for bats during a night survey in Transylvania County.



Battleground FOR BATS

White-nose syndrome continues to wipe out hibernating bat populations in western North Carolina, yet biologists and researchers hold out hope for better days ahead

WRITTEN BY **JOSH LEVENTHAL** | PHOTOGRAPHED BY **MELISSA McGAW**

Katherine Caldwell can only imagine how exciting the good old days of bat research must have been in the mountains of North Carolina. A mammalogist with the N.C. Wildlife Resources Commission, Caldwell has heard stories from her peers of bats lining the walls of caves and mines, seemingly almost too many to count.

Populations of tricolored bats (above) hibernating in western North Carolina caves and mines have declined by more than 90 percent in less than 10 years due to white-nose syndrome. Below: A hoary bat is measured during a mist-net survey. Right: Katherine Caldwell rappels into a cave during a bat survey.

The tales are all true—Caldwell can point to the historical data as proof—but are not from some bygone era, like when fields were flush with coveys of quail in the early and mid 20th century. In fact, bat populations in the western part of our state were plentiful earlier this decade; yet, for Caldwell and other bat researchers, it might as well be an eternity.

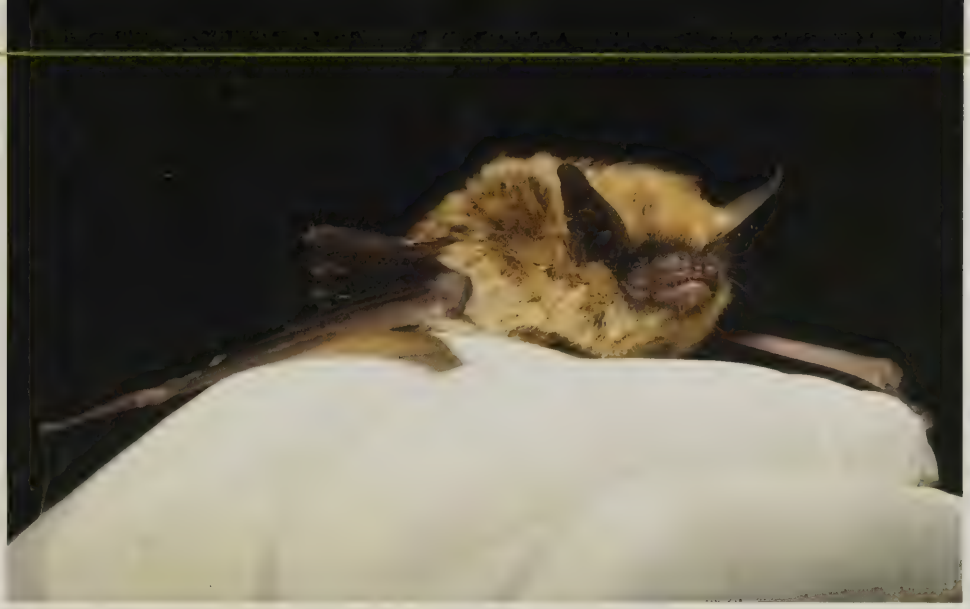
Everything changed with the arrival of white-nose syndrome, a fungus that infects hibernating bats and has decimated bat populations in the East and Midwest, and in western North Carolina since its arrival here in 2011. That also happens to be when Caldwell began studying bats in North Carolina.

"Where I am in the mountains, it's a grim picture," said Caldwell, a Concord native who joined the N.C. Wildlife Resources Commission two years ago. "It's hard because we do all these surveys that are really cool. Caving is fun and interesting and a physical challenge. But it is bittersweet because I have these historical records that I look at before I go to each cave. The numbers now pale in comparison to what used to be here."

That is putting it mildly. Hibernating populations of six of the 17 species of bats found in North Carolina have been impacted by the outbreak of white-nose syndrome, with three species all but disappearing from their usual caves and mines in the western part of the state. Spots that used to host thousands of hibernating bats are now left with mere dozens.

"I had the privilege of joining Wildlife Commission biologists for a few surveys before we saw the dramatic decline, and I am thankful that I got to see them," said Sue Cameron, an endangered species biologist with the U.S. Fish and Wildlife Service based in Asheville. "There were huge clusters of bats. You could spend all day at some of the big mines counting bats. Sadly, it is not like that anymore. We don't have big clusters of bats."

Yet, even amid such massive declines in bat populations, biologists find reasons for optimism. They remain hopeful—almost out of necessity—about the future of bats in our state, whether it's the few survivors from colonies that have been otherwise wiped out, the absence of white-nose syndrome in bat populations in the Coastal Plain and most of the Piedmont, the research being conducted that could lead to treatment options for the disease, or the increased



White-nose syndrome has impacted eight species of bats in North Carolina, including the Eastern small-footed bat, whose hibernating populations in western caves and mines have decreased by 55 percent since 2011.

awareness about the important role bats play in our ecology.

"There is nothing like a silver bullet that is going to fix this," Cameron said, "but there are some promising things on the horizon that could be used with other strategies to help our bats."

Added Caldwell: "In my mind, there is always a reason for optimism. You can't work with bats if you don't have that optimism because so much [of our work] is discussing the declines and seeing the declines. You have to look hard for the optimistic portions, but there are some."

A DEADLY FUNGUS

That optimism, however, is buried beneath a harsh reality: White-nose syndrome has killed bats at an alarming rate. The disease was first discovered in New York in the winter of 2006–07 and has since spread to 33 states and five Canadian provinces, according to the U.S. Fish and Wildlife Service, whose recent studies estimate that more than 6 million bats have died from the disease. While no practical treatment for the disease has been discovered, research continues on potential treatments, and strict protocol has been developed for researchers to limit contamination and spreading of the disease.

Named for the white fungus that appears on the muzzle, nose and ears of infected bats, white-nose syndrome (*Pseudogymnoascus destructans*) grows best in temperatures ranging between roughly 50 and 60 degrees Fahrenheit. Those are the same temperatures that bats prefer during hibernation, which make their cold, humid caves and mines a perfect incubator for white-nose syndrome.

A bat's body temperature and metabolic rate also decrease during hibernation—a physical state called torpor, which reduces energy expenditure during winter—making it susceptible to white-nose syndrome.

"It is kind of a perfect fungus for bats to be a host of," Caldwell said.

Bats often huddle together during hibernation, making it easy for the fungus to spread from bat to bat. Scientists believe that the fungus irritates hibernating bats and causes them to awaken from their slumber to clean themselves. Doing so requires them to expend energy and use fat reserves needed to survive the winter when their food and water sources are not available. As those fat reserves decline, infected bats often act erratically, flying outside during the day in freezing temperatures or grouping in clusters near the entrance of a cave or mine. The disease kills bats by invading their tissue and disrupting their physiological functions or causing bats to starve to death or die from water loss or exposure to cold temperatures.

"Treating wildlife diseases is very difficult to do," Commission Western Wildlife Diversity Supervisor Kendrick Weeks said. "Once you have a disease that comes in, you can't really stop it."

So far, that has proven to be the case with white-nose syndrome. Three species of bats that hibernate in western North Carolina have been impacted most severely by the outbreak of white-nose syndrome: the little brown bat, Northern long-eared bat and tricolored bat. All three were common before the arrival of white-nose syndrome but are now found far less frequently during biologists' surveys of bat populations. In fact, the Northern long-eared bat was federally listed as Threatened in 2015 because of white-nose syndrome; the other two are currently under review for listing.

Biologists use different methods to count and study bats. In winter months, biologists count and inspect bats in the caves and mines where they hibernate. In warmer months, biologists spread out mist nets in areas bats frequent to catch, count and release them. They also visit bat roosting sites and use acoustic detectors to count bats. While the differing methods can provide varying results, they all point to significant declines in the populations of little brown, Northern long-eared and tricolored bats.

For example, hibernating populations of Northern long-eared bats are down 100 percent since 2011 in western North Carolina caves and mines, compared to an 84 percent decline of the species found during mist-netting surveys in other parts of the region. The variation between the two studies does present questions—like if the remaining bats captured in mist-netting surveys have found somewhere else to hibernate, Weeks said—but do reveal a significant decline in their population.

NATURE'S WAYS

Do Bats and Birds Fly the Same Way?

See Nature's Ways, page 43

A biologist inspects an Eastern red bat captured during a mist-netting survey before tagging and releasing it. The latex gloves worn by biologists are changed after inspecting each bat to avoid cross-contamination.

"Any one survey technique has biases," Weeks said. "You can get a better, or more precise, picture when you have more techniques. Hibernacula is only one technique. Only certain bats hibernate, or are in areas that humans can get to . . . There is obviously a decline, but getting a handle on the real extent is much more important."

Meanwhile, hibernating populations of the tricolored bat—which weighs a mere 4 to 10 grams and can be mistaken for a large moth—are down 96.3 percent, compared to 66 percent in mist-netting surveys. The little brown bat has seen a 93.5 percent decline in its hibernating population and a 92 percent decrease in mist-netting surveys.

What do these declines look like to a bat researcher in the field? Caldwell points to a mine in Haywood County that in a 2011 count had 3,969 bats—the most ever for that location. When Caldwell visited it last year, she counted just 30 bats. "We have to hunt for every bat that we find in our surveys," she said.

Weeks recalls a bridge over the Little Tennessee River that used to be the site of a regular nursing colony for hundreds of little brown bats and a spot where his team would regularly conduct mist-netting surveys. "Within two years of [white-nose syndrome's] arrival, it was wiped out," he said.

Adding to the long road to recovery for bats is that they typically give birth to only one or two pups per year, so repopulating the various hard-hit species is going to take time.

"[This] makes bat populations naturally slow to increase," Caldwell said. "To make matters worse, white-nose syndrome survivors may not be healthy enough to reproduce, they may have trouble finding mates or there may be too few pregnant females to form a maternity colony, which is essential for pup rearing for many species. These factors could make an already slow process even slower, but the hope is that enough of these survivors exist to eventually rebuild populations."

Those declines have begun to level off in recent years, Weeks said, which does provide hope for the future of the species.

REASON FOR OPTIMISM

White-nose syndrome was on Cameron's radar when she joined the U.S. Fish and Wildlife Service in 2009. Cameron, like other biologists in the region, hoped for the best but braced for the worst as the disease steadily spread south from New York.

"We knew it was just a matter of time," Cameron said. "There was always a little bit of hope before it reached the Southeast that maybe things would be a little different here that would prevent the mass mortality. We were a little bit hopeful, a little glimmer of hope that things would be different. But we expected it to show up and that it would cause mortality. It certainly was devastating. Even when you were expecting it, it was rough to see the [bat] numbers decline. It didn't take long, just a couple of years to see these drastic drops."

Those declines have begun to level off in recent years, Weeks said, which does provide hope for the future of the species. That leveling off could be due to some survivors displaying a resilience to the disease—which has happened where the disease originated in Europe, where some bats can now survive being infected—or simply because fewer bats means fewer spores of the fungus are being spread.

"The pattern has basically been that two years after we detect [white-nose syndrome], the populations plummet, then level off," Weeks said. "That leveling off is reason for optimism."

It is not the only reason. Biologists note that some species of bats whose populations are dwindling in the mountains are thriving in the Coastal Plain. Northern long-eared bats and tricolored bats have been recorded during mist-netting surveys in the Coastal Plain, as well as through acoustic surveys. These findings in regions where bats have not been as thoroughly studied are encouraging. Since these bats either don't hibernate or hibernate for only a short period of time in the Coastal Plain, they are less susceptible to white-nose syndrome.

"I am really hopeful about the Coastal Plain," Cameron said. "There is a lot to learn about bats on the Coastal Plain. Most of the bat work historically has been done in western North Carolina. It appears that those bats are doing something different. I am hopeful that will offer some protections to those species. Frankly, for me, having those coastal populations gives me hope that the species will survive."

Further protections for species of bats impacted by white-nose syndrome are a

Clockwise, from above: An identification tag is placed on the wing of an Eastern red bat. Wildlife Resources Commission Mammologist Katherine Caldwell documents the results of her survey work, including how much each bat weighs and its identification tag. Below: Caldwell (center), wildlife technician Joey Weber (left) and caver Scott McCrea seal their coveralls with duct tape before a survey in Transylvania County.

possibility, with the tricolored and little brown bats being considered for federal Endangered and Threatened listing. Such a listing could provide more funding and resources for research and would protect them from direct mortality from other sources. Currently, four species of bats that occur in North Carolina are listed: Northern long-eared, gray, Indiana and Virginia big-eared.

Being on the front lines of white-nose syndrome has been a challenge for bat researchers—both professionally and personally. Yet what leaves them most encouraged about the future is the awareness about the importance of bats raised in the general public. Bats are most often associated for their roles in horror movies or scary campfire stories than for their important contributions to our ecosystems. All bats in North Carolina are insectivores that can typically eat their weight in insects daily. Not only do they reduce the number of mosquitoes people have to swat, bats also impact our agricultural industry. According to the U.S. Geological Survey, bat loss could cost North American agriculture more than $3.7 billion per year.

"To me, the biggest silver lining is the awareness that has been raised about bats," Cameron said. "For a long time, bats have been feared and even persecuted. The one good thing that has come out of this is it shows how important bats are to us . . . They are a major predator of night-flying insects and human pests, like mosquitoes. Bats make a big difference in our lives."

Weeks agrees, and remains optimistic of better days ahead for bats. "People are learning more about bats and not being afraid of them, and understanding them and wanting to conserve them," he said. "So, in the long run, this will have a great effect on public support for conserving bats, and understanding how important they are for ecosystems and just how neat they are. I have optimism that the three main species that have been severely affected [Northern long-eared, little brown and tricolored] will recover. It will just take time."

Josh Leventhal is the editor of Wildlife in North Carolina. *He can be reached at josh.leventhal@ncwildlife.org*

More than just weeds and leaves . . .

Early Successional Habitats Are A Secret Hideout for Wildlife

written by Sydney Brown
illustrated by Amelia Hansen

Have you ever noticed tall grasses dancing in the wind along a roadside or in a field? Their leaves and stems sway and bend with nature's wind songs. Plants with funny names can be found on this wide-open natural stage, like pink muhly grass or black-eyed Susan. Notice the variety of colors that set apart the golden rod from the muhly grass, the black-eyed Susan from the rest of the asters.

These plants are part of an early successional habitat. Early successional means toward the beginning. Succession is the replacement of one thing by another over time. A habitat is the natural environment in which an animal or a plant lives and gets the air, food, water and shelter it needs to survive. So, an early successional habitat is the beginning of a new habitat replacing another one that has been destroyed, often by a fire or a storm knocking down trees or humans clearing plants from the land.

GETTING INTO THE WEEDS

Have you ever noticed when a person does not mow the lawn for a while? Have you seen what pops up? The first things to grow are clovers, dandelions, ragweed, beggar's lice and trumpet creeper. Many folks consider these to be weeds and want to get rid of them, but these plants are critical to the survival of young wildlife. These plants provide food and shelter for our animals. Without these plants, many insects, mammals, reptiles and birds couldn't survive.

Bees, wasps and butterflies spread pollen from plants in early successional habitats so seeds will grow from fertilized flowers. Birds that have their nests on the ground, like quail and turkey, eat the plant seeds and build their nests in the grass and wildflowers. Beetles, wasps and butterflies lay their eggs on the plant stems and inside the plant leaves. Later, baby birds, fox and rabbits eat the larva hatching from those eggs, giving those babies the protein and fats they need. Anoles and other lizards dine on the adult insects and spiders that live in the habitat.

HELPING NATURE

Fires used to naturally spread across the land and early successional habitats could be everywhere. Humans now prevent those fires from spreading, so buildings and humans are unharmed.

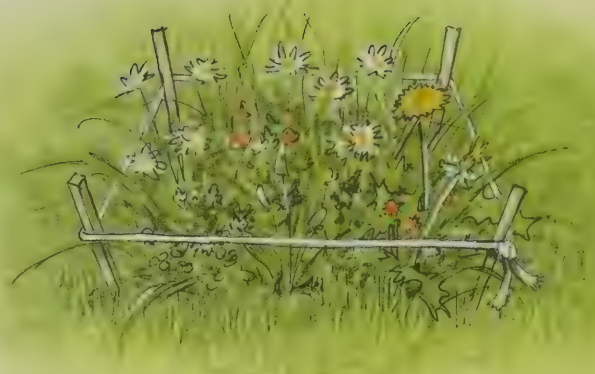
Many people work hard to make sure early successional habitats do not disappear. Earlier we defined what succession means: "the replacement of one thing by another." Without being managed, weeds will turn into woody stems, and stems into trees. Over time they will grow into a forest. The habitat would turn into another one entirely.

Why is this a bad thing? Well, what do you see when you look at the forest floor? You'll probably find pine straw, leaves and twigs. You see none of the tall grasses, shrubs and flowers that many insects and birds need.

By using fire, disking or mowing, people can help maintain early successional habitats. Professionals do controlled burning or use big equipment for disking and mowing to turn and disturb the earth. These methods prevent the growth of trees that would otherwise shade and kill the early successional plants.

Get Outside

Early successional habitats are not all the same. They can be found from the coast to the mountains in grasslands, old fields, pastures and shrub thickets. Each one supports a unique plant and animal life. Visiting an early successional habitat is a great way to see different wildlife and plants. Talk to your parents about visiting one of our game lands, like Holly Shelter, Sandhills, Voice of America, Roanoke River and Sandy Mush. These are all great areas to see the different species that live in early successional habitats.



A HABITAT OF YOUR OWN

The many diverse types of wildflowers, clover and grasses that can be found in early successional habitats support many different types of animals. Try this experiment at home and see what you can find.

First, check with an adult and then start gathering materials.

MATERIALS:

- rope
- stakes
- a measuring tape
- a clipboard with paper.

DIRECTIONS:

1. After you have your materials, you will need to measure a 3-by-3-foot square in your yard around a patch of grass. This square cannot be mowed, treated or disturbed for the next month. Pick two days out of each week to go visit the patch of grass and count the number of species you see. These species include plants and animals. You will need to stay very still and watch for at least 15 minutes to make sure that you get a good count
2. Make sure you look closely at each plant and animal so you aren't double counting. If you see two carpenter bees, for example, that counts as one species. Write down everything that you see on your clipboard, along with the date of when you saw it.
3. At the end of the month, count the number of species and see if there is a difference since the beginning of the month.

Guess what? There should be a difference!

As long grasses begin to grow and produce seed, a variety of wildlife will become attracted to it. Insects and birds will probably be the first creatures that you see visit, and then maybe even more wildlife will come to your spot. If you would like to expand upon this experience, trying doing this in the woods, on the edge of a stream or lake, or in a big open meadow. Remember, the more you look the more wildlife you will see.

Commission Honors Retired Biologist, NWTF Chapter with Deidrick Awards

The N.C. Wildlife Resources Commission honored former Commission biologist Terry Sharpe and the N.C. Chapter of the National Wild Turkey Federation with Lawrence G. Deidrick Small Game Awards for their contributions to aid wildlife that depend on early successional habitats.

Sharpe, of Ellerbe, has been a leader in small game management in North Carolina for nearly 40 years. Sharpe spent 30 years with the Commission before retiring in December 2006 as an agricultural liaison biologist. He led efforts as a small game project leader and was instrumental in creating improved habitat for quail. He has previously been honored as the Southeastern Association of Fish and Wildlife Agencies' biologist of the year and received Quail Unlimited's lifetime achievement award.

In retirement, Sharpe continues to promote management for small game. He has been involved with the N.C. Prescribed Fire Council, The Wildlife Federation and the LandTrust for Central North Carolina. He regularly serves as a guest speaker at meetings, conferences and workshops, and is always willing to share his knowledge and discuss management options with other professionals.

Sharpe also inspires others to explore and appreciate the natural world. He has been involved with the Fur, Fish & Game Rendezvous for many years, and he coordinates a crow hunt as part of this 4-H summer camp that allows youth from many backgrounds to experience hunting.

The National Wild Turkey Federation's North Carolina Chapter (NWTF-NC) has a long history of providing funding and equipment for North Carolina projects that have benefits for species far beyond turkeys, including numerous small game and nongame wildlife species.

MELISSA McGAW/NCWRC

MELISSA McGAW/NCWRC

Left: Wildlife Management Chief David Cobb congratulates retired biologist Terry Sharpe for winning a Deidrick Award. Right: The North Carolina Chapter of the National Wild Turkey Federation receives a Deidrick Award for its conservation efforts.

In 2016, NWTF-NC donated $21,343.50 for four Wildlife Commission projects involving reclamation of old open land areas, establishment of new open land areas, and purchase of equipment to manage ground cover vegetation.

In 2017, NWTF-NC obligated $50,575 for seven Wildlife Commission projects involving contract prescribed burning and purchase of equipment to create or maintain early successional habitat. These recent projects, as well as numerous past projects that have received NWTF-NC support, have benefited numerous small game species such as rabbit, quail, woodcock and grouse in all regions of the state.

The NWTF-NC has shown a long-term commitment to fund or otherwise support quality habitat management practices that benefit small game and other wildlife species while enhancing a strong partnership with the Wildlife Commission.

The Lawrence G. Deidrick Small Game Award is given annually, or when appropriate, by the Commission to individuals and organizations whose actions significantly and positively impact many of North Carolina's small game populations (including bobwhite quail, ruffed grouse, squirrel and rabbit). The award is named for the late Larry Deidrick, a lawyer and wildlife commissioner from 1993 to 2001 from Rocky Mount who died in 2002. Deidrick was a passionate small game hunter and conservation advocate throughout his lifetime.

e NEWSLETTER

Get N.C. Wildlife Update—news including season dates, bag limits, legislative updates and more—delivered to your Inbox from the N.C. Wildlife Resources Commission. Sign up at ncwildlife.org/enews.

Who Can Identify the Most Wildlife?

N.C. State researchers who asked elementary school students to name five wild animals native to North Carolina found a connection between kids' biodiversity knowledge and hunting experience.

Among the 440 students surveyed in third and fifth grades, those who said they had been hunting could correctly identify native wildlife species 73 percent of the time, compared with 63 percent of students who hadn't been hunting.

"Among the students we surveyed, hunting was prevalent," said Nils Peterson, associate professor of fisheries, wildlife and conservation biology in the College of Natural Resources. "About 29 percent of North Carolina students reported that they had gone hunting—higher than the national average of 24 percent—and that experience was a positive predictor of native wildlife knowledge."

Minority and female students, who reported hunting at lower rates than white males, scored lower on biodiversity knowledge, and fewer said they thought that people should hunt. Researchers note that students may have included activities that don't meet the general definition of hunting, such as attempting to capture lizards or insects, in their responses.

Peterson said 22 percent of girls reported hunting, compared with 38 percent of boys. Fewer minority students took part in hunting—9 percent of Hispanic, 18 percent of black and 30 percent of Native American students, compared with 42 percent of white students.

The survey is one of several environmental education studies examining how students learn about biodiversity and whether they have an interest in conservation biology, which relates to protecting species in the future.

The N.C. Wildlife Resources Commission encourages children to get outdoors, whether through hunting, fishing or other outdoor recreation activities. Visit ncwildlife.org/hunting for more information on hunting in North Carolina, including skills seminars, hunter education opportunities, hunting seasons and places to hunt.

"Future research on outdoor activities that can improve students' knowledge of biodiversity should look at hunting along with choices such as hiking, camping, fishing, canoeing and beachgoing," Peterson said. "Knowing about animals that are native to North Carolina is a precursor to caring about them."

Peterson co-authored the study with Tessa Chesonis, who earned an undergraduate degree through the Fisheries, Wildlife and Conservation Biology program; Kathryn T. Stevenson, an assistant professor in the Department of Parks, Recreation and Tourism Management; and Howard D. Bondell, an adjunct professor in the Department of Statistics. A version of this article was originally published by N.C. State University.

IN SEASON

In May and June, these seasons are open in North Carolina:

Wild Turkey: (male or bearded only) Through May 12

Delayed Harvest Trout Waters: June 2–July 31 (On June 2 from 6 a.m. to noon, only youths under the age of 18 can fish)

There is no closed season or bag limits for feral swine, groundhog, striped skunk, nutria and armadillo. There is an open season for taking beaver with firearms or bow during any open season for the taking of wild animals. Check with the latest *North Carolina Inland Fishing, Hunting and Trapping Regulations Digest* for bag limits and applicable maps or visit ncwildlife.org.

Commission Approves Changes to Deer Hunting Regulations

The N.C. Wildlife Resources Commission voted on Feb. 28 to adopt rules related to wildlife, fisheries and game lands management for the 2018–19 seasons. The effective date for these changes is Aug. 1, 2018.

Throughout the public hearing process, the Commission received passionate, well-articulated concerns from constituents regarding the cultural and traditional impacts of proposed deer season changes. Commissioners carefully weighed those comments along with biological information and decided to adopt the following:

- Implement a statewide bag limit of two antlered and four antlerless deer.
- Bonus Antlerless Deer Harvest Report Cards are restricted to the Urban Archery Season only.
- Deer Management Assistance Program (DMAP) participants would retain harvest flexibility.
- Shift either-sex days to the beginning of the Introductory, Conservative and Moderate Gun Either-Sex Seasons.
- Move Polk, Rutherford and Cleveland counties to the Northwestern Deer Season, and retain the Moderate Gun Either-Sex Season.

The Commission adopted rules to align bear hunting seasons in the Coastal Bear Management Unit (CBMU) with the five bear hunting zones with one modification: moving Pamlico County into Zone 5 of the CBMU. Additionally, the Commission disapproved the proposal to add two weeks to bear hunting season in the Mountain Bear Management Unit.

Regarding changes in deer bag limits, Division of Wildlife Management Chief Dr. David Cobb said, "The purpose of going to a two-buck statewide limit and four-doe limit is try to better align the sex ratio of the deer herd going into breeding."

Cobb added that the Commission conducted three years of biological data collection statewide. Based on the data, the Commission could better manage the deer herd by reducing the antlerless limit to four and eliminating the bonus antlerless tags [over the counter]. Those changes should result in improvements to the deer herd and herd dynamics for deer hunters, Cobb said.

CALENDAR OF EVENTS

Tuesday–Saturday, June 5–9

Head over to the Pechmann Fishing Education Center in Fayetteville for angling activities during National Fishing and Boating Week. Events include a Family Fishing Workshop on June 5, a Basic Coastal Navigation Workshop on June 6 and 7, and a Youth Fishing Day on June 9. The first 200 kids to check in will receive a free tackle box and a grab bag with fishing-related items.

For more information, call 910-868-5003 or visit ncwildlife.org/Learning/Education-Centers/Pechmann.

Friday–Saturday, June 8–16

The 60th Annual Big Rock Blue Marlin Tournament returns to Big Rock Landing in Morehead City. The main tournament kicks off Monday and runs through Saturday. Spectators can come by the landing each afternoon to see if any marlin are brought to the scale, as well as "meat fish" (yellowfin tuna, dolphinfish and wahoo). Last year's winning boat "Run Off" collected over $1 million in prizes. The tournament has raised over $4 million for charities since 1986. For more information, visit thebigrock.com.

Readers should check with the contact listed before traveling to an event. Items for listing should be conservation-oriented and should be submitted at least four months in advance to mike.zlotnicki@ncwildlife.org, or call 919-707-0175.

LIFETIME LICENSES

Help conserve wildlife for future generations. In 1981, hunters, anglers and wildlife enthusiasts became shareholders in an innovative investment and conservation program called the North Carolina Wildlife Endowment Fund.

Today, the commission has 19 different lifetime licenses in five categories: Infant, Youth, Adult, Senior and Disabled.

The endowment fund for wildlife was a simple yet revolutionary idea: Create a lifetime inland fishing or hunting license. Put the license fees into a special fund. Spend the accrued interest, not the principal, on programs and projects that benefit fish and wildlife. To learn more or to purchase a lifetime license visit ncwildlife.org/licensing or call 1-888-248-6834.

New Duck Stamp Features Pair of Canvasbacks

A painting of a pair of canvasbacks by Florida artist Garrett Jacobs was selected as the 2018 North Carolina Waterfowl Conservation Stamp and Print. The acrylic painting, which was unveiled on Feb. 8 at the Wildlife Arts Festival in downtown Washington, will be used as the artwork on the 2018 N.C. Waterfowl Stamp and Print. Signed and numbered regular edition prints with mint stamps will be available July 1 from the N.C. Wildlife Resources Commission's N.C. Wild Store for $148 (ncwildstore.com).

"If you look at the painting, you'll notice that the colors of red, white and blue are present," said Jacobs, who was among 31 wildlife artists from 18 states to enter the competition. "With the appearance of a mist of uncertainty looming in the background, my statement with this piece is that not only is America great, but our land, our people and our world of wildlife are still beautiful."

The duck stamp competition began in 2008 as a partnership between the Commission and the East Carolina Wildfowl Guild. Today, the competition is managed by the Washington Tourism Development Authority.

"Each year we hear from artists about the caliber of the North Carolina competition," said Lynn Davis, tourism director of the Washington Tourism Development Authority. "This year was no different. Notable and award-winning waterfowl artists from throughout the United States participated. The North Carolina competition has become the 'who's who' in the duck stamp world."

In addition to Jacobs' painting, the other top entries selected by a panel of judges were unveiled at the festival:

2nd place—Broderick Crawford (Clayton, Ga.)
3rd place—John Brennan (Lutz, Fla.)
4th place—Jeffrey Klinefelter (Etna Green, Ind.)
5th place—Guy Crittenden (Richmond, Va.)

Proceeds from sales of the print and stamp support the Wildlife Resources Commission's Waterfowl Fund, which generates revenue for conservation of local waterfowl habitat. To view a gallery of this year's entries, visit: littlewashingtonnc.com/nc-duck-stamp.

Alligator Permit Framework in Place

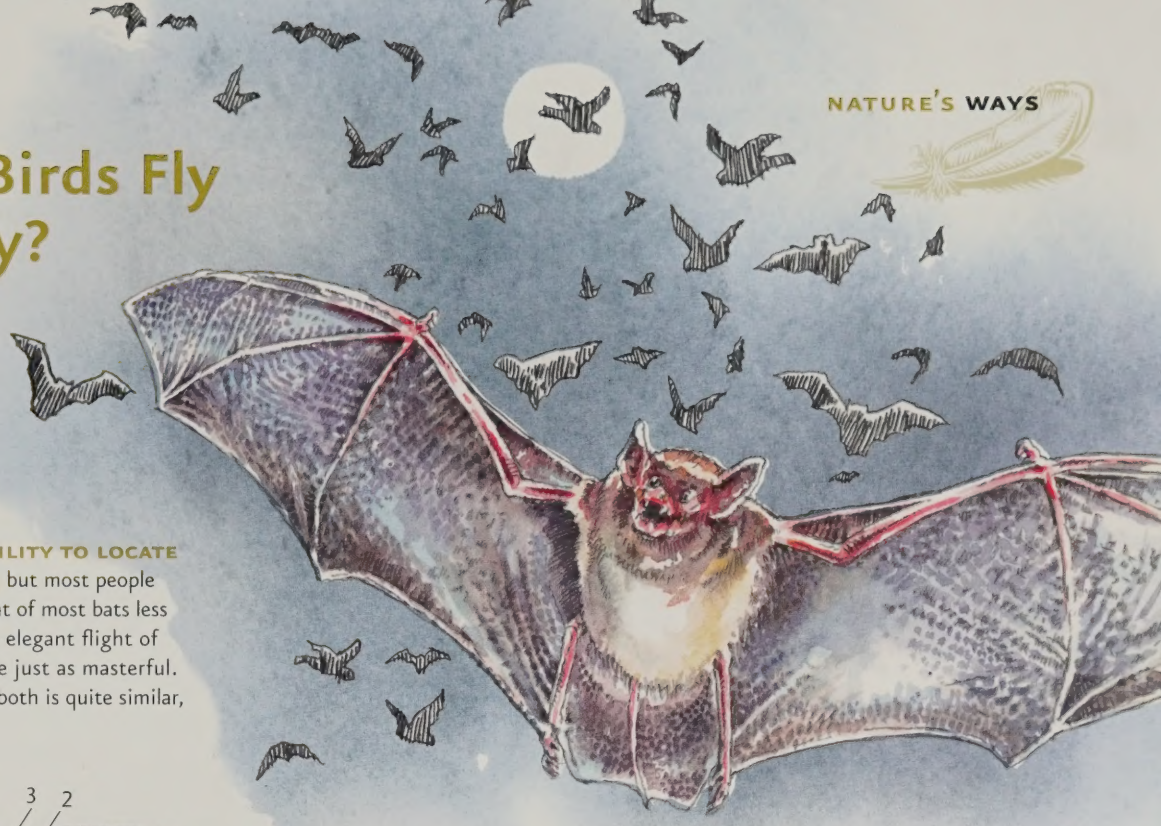
The North Carolina Wildlife Resources Commission adopted a rule to allow limited take of American alligators as prescribed by the North Carolina Alligator Management Plan. In accordance with the plan, hunting for American alligators will initially be limited to population reduction hunts at the request of cities, towns and villages within Alligator Management Unit 1 (Brunswick, Carteret, Columbus, Craven, Hyde, Jones, New Hanover, Onslow, Pamlico, and Pender counties).

A municipality requesting a population reduction hunt will work with Commission staff to assess alligator numbers, define areas of public safety concern and identify where alligator take could be safely conducted.

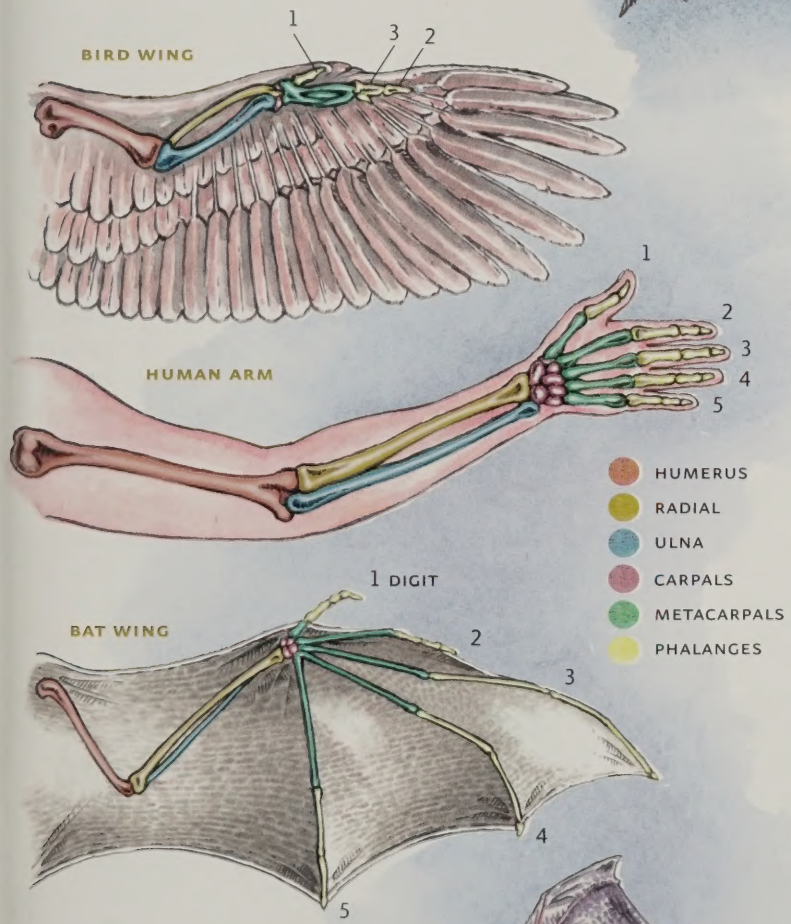
The Commission does not plan to issue permits to take American alligators, outside of municipality requested population reduction hunts, until further research is conducted to determine the conditions under which alligator populations would be sustained while allowing limited harvest.

Do Bats and Birds Fly The Same Way?

written by Clyde Sorenson
illustrated by Jim Brown

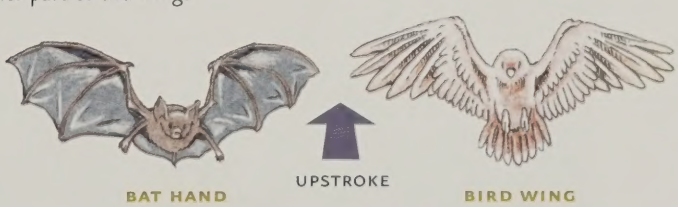


BATS ARE FAMOUS FOR THEIR ABILITY TO LOCATE PREY THROUGH ECHOLOCATION, but most people probably find the fluttering, erratic flight of most bats less impressive, especially compared to the elegant flight of many birds. But in many ways, bats are just as masterful. And while the basic process of flight in both is quite similar, there are some important differences.



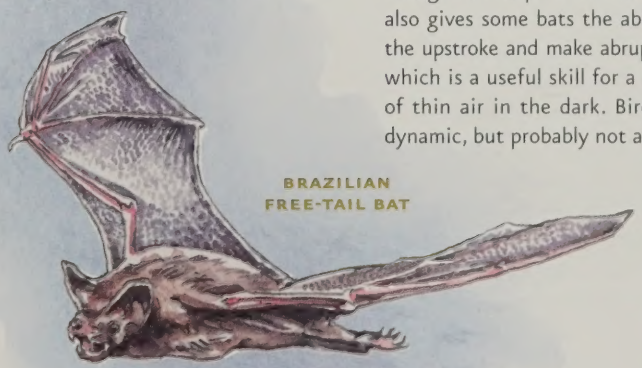
The wings of bats and birds evolved from the forelimbs of their quadrupedal ancestors, but they are arranged somewhat differently. The bulk of a bird's wing is supported by the arm bones—the bones of the hand are highly reduced and fused. The arm bones support the tertial and secondary feathers that generate most of the lift for the bird, while the hand supports the primaries that provide most of the propulsion.

The bulk of a bat's wing, however, is supported by the bones of the bat's hand—mostly the four fingers since the thumb in most bats is not webbed with the rest of the wing. The actual surface of the bat's wing is the flexible skin membrane stretching across the hand and to the hind leg. As in birds' wings, much of the lift is produced by the inner part of the wing.



The bat's hand has all the joints that a human hand has—and perhaps a couple more. This gives the bat an amazing ability to change the shape of the wing, particularly on the upstroke. It also gives some bats the ability to generate additional lift on the upstroke and make abrupt maneuvers, even at slow speeds, which is a useful skill for a creature snagging live insects out of thin air in the dark. Bird wing shapes are also extremely dynamic, but probably not as dynamic as bats'.

Don't think that all bats are slow, fluttery critters. The Brazilian free-tailed bat (which can be found in North Carolina) has been clocked at almost 100 mph!



Children of the Moon

written by Jim Dean

To honor the memory of our colleague and friend, Wildlife in North Carolina *will publish our favorite Jim Dean columns for the remainder of 2018. "Children of the Moon" was originally published in May 1991.*

"The child is father of the man," wrote William Wordsworth in the opening line of his ode, "Intimations of Immortality." Some would say that explains a lot of shortcomings, though perhaps not nearly enough. Indeed, had Mr. Wordsworth written his ode today, I suspect he might have run afoul of the Truth in Poetry Act of 1990 and been required to add, "except for those children who suffer severe cases of arrested development."

Some of us don't, you know. Grow up, that is. I myself have had some practical experience in the arena of extended childhood, and I've found it becomes most noticeable each May as the full moon appears in the balmy night sky. That bright and perfect orb mysteriously drives billions of fat bluegills and shellcrackers to their spawning beds with the urge to beget while the begetting is good. The prospect of all those begetting bluegills strips the years from ancient anglers and makes us crazy.

"If you don't have a truck, the proper way to carry cane poles is sticking out a rear window where they serve a 'nose-thumbing' role for any passing motorist who isn't fortunate enough to be going fishing."

Like many moonstruck anglers, my long-time panfishing buddy and I indulge certain traditions during this once-a-year rite. It is, for example, essential that Jack and I make this particular passage in his 1956 Granny Smith apple green Ford truck. Even without the '57 Thunderbird V-8, three two-barrels, dual steelpacks and flames painted under the hood, this is the perfect chariot to carry a pair of senescent, perch-jerking partners back to the future.

We load the rear bed with a wooden pond boat, a 48-quart cooler, a couple of cricket cages and enough rods and cane poles to stock a K-Mart. The first stop is always at the same tackle shop we've frequented for years, and the banter is always the same. "Fill 'em up with insects," says Jack, setting the cages on the counter. "High test. We want maximum chirps per gallon."

We negotiate the last mile of a dirt path and launch the boat in the pond. The truck is filled with the sound of crickets singing boldly in the face of doom, and we join them—"Give us some crickets who are stout-hearted . . ."

Tradition calls for a light cane pole about 14- to 16-feet long, a sliding cork and a couple of small split shot pinched on the line above a No. 8 or 10 hook. If you don't have a truck, the proper way to carry cane poles is sticking out a rear window where they serve a "nose-thumbing" role for any passing motorist who isn't fortunate enough to be going fishing.

Once the boat is launched and loaded with our tackle and provisions, the biggest problem is finding room to sit. But we manage, and with decent weather and any luck at all, the fishing is always good. We seek the larger spawning areas, looking for countless circular depressions fanned out by the fish. They are often easy to spot along the banks or on shallow flats, and we can smell those too deep to see. As the action slows in one area, we move to another, baiting hooks with the same musty, unwashed hands that hold our sandwiches.

Late in the afternoon, slathered in suntan lotion and insect repellent, we drift contentedly under the warm sun, listening to the slap of water on the hull and the rasp of redwing blackbirds. Stretched out with hands behind our heads and feet dangling in the water, we watch puffy cumulous clouds that invariably form the shapes of chickens. (Why is that, anyway? Is some obscure science at work here?)

For once, no one is thinking about deadlines and quotas. It is simple and timeless fishing that tends to blur memory so that you cannot be sure if it was four years ago that you caught a 26-ounce bluegill, or 26 years ago that you caught a 4-ounce bluegill.

I don't know what Jack thinks about, but I am often transported to identical days 40 years earlier when my father or grandfather and I drifted across old millponds under shaggy cypress. Once again I am 10 years old, lean and brown as a berry, and there's hair on my head. I have my wonderful bobber that whistles when a bream bites, and my hands smell like worms. The immortal redwings sing to me, and there is no intimation that this will ever end.

On the way back home, Jack and I tune in an oldies station and listen to the songs of our youth over the invigorating growl of the exhausts. Roy Hamilton, Johnny Ace and Bobby Blue Bland join the chirps of surviving crickets.

A new 300 ZX turbo pulls alongside at a stoplight, and the driver glances over and revs the engine, confidently issuing an age-old challenge. His last incredulous, open-mouthed look at this rumbling ghost from the '50s is out of the rear end of a boat full of bluegills, poles and flapping corks nestled between two swiftly disappearing taillights.

"Don't mess with the forever young," Jack says. Shirley and Lee are singing "Let the Good Times Roll." We do.

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"Youth is happy because it has the ability to see beauty.
Anyone who keeps the ability to see beauty never grows old."
–Franz Kafka
RICK SMALL

white-tailed deer fawn

OUTDOOR MOMENT

IN THE JULY • AUGUST ISSUE

TODD PUSSER

THE VENOMOUS SIX

Learn how to identify the six different species of venomous snakes that live in North Carolina, including the timber rattler.

IN THE ZONE

Not all spots on an ocean fishing pier are created equal. Where you stand can impact what you might catch.

CARVING OUT A FISH NICHE

Henry Snuggs has taken his love of fishing to new heights by creating folk art sculptures of fish so realistic they appear ready to be hooked.

Wildlife

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